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STATE COMMISSION OF HORTICULTURE

January, 1912

THE MONTHLY BULLETIN

)LUME I No. 2

)evoted to the Descriptions, Life Habits and Methods of Control of Insects, Fungoid Diseases and Noxious Weeds and Animals, Especially in Their Relations to Agriculture and Horticulture

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1912

PEAR BLIGHT CONTROL.

By Ernest A. Gammon, Courtland, California.

(As given at the Fortieth State Fruit Growers' Convention at Santa Rosa, December 19–22, 1911.)

Waite defines pear blight as a contagious bacterial disease affecting the pear and allied fruit trees, such as apple, quince, crab apple, also ash and hawthorn.

It attacks and rapidly kills the blossoms, young fruits and tender twigs; runs down the living bark to lower limbs and trunk of tree, or

Fig. 12.—Pear tree treated for pear blight. Entire side of trunk removed. (Original.)

it attacks sprouts and suckers around the tree, and runs down the bark of these to the root proper, trunk, or crown.

Its first appearance in the spring is in the form of black or blighted flowers, young fruits and twigs.

In the fall the foliage turning to dark red before the majority of leaves has changed, is a very suspicious sign of the disease. Careful inspection of the limb, trunk, and crown just below or under the suspicious limb is the correct method of determining whether or not blight is present. This is shown in the cuts which are herein included.

One of the most serious aspects is that the microbes live and multiply in the nectar of the blossoms, and bees, bugs, flies, and birds readily carry these microbes from blossom to blossom, from tree to tree, and from orchard to orchard. For this reason it is very difficult to control this disease.

One neighbor may be neglectful, thus furnishing a starting or seeding place with enough contagion present to ruin all orchards for many miles.

The only remedy recommended by the best authorities is the use of the knife and saw—thoroughly disinfecting after each cut.

Soon after the first appearance of the dread disease in our county, Mr. M. B. Waite of the Department of Agriculture called at our farm. We fully discussed the disease, manner of control, and probable expense.

I asked, "Will this pay?" He replied, "How many pears do you raise each year, and what is the usual price?" Then he said my method or system of pruning must be changed, all spurs or lower limbs and all suckers must be kept off, and all diseased parts of the tree must be removed, and where impossible to clean up a tree by cutting out diseased wood, to remove the tree.

After comparing cost of the plan outlined and the net returns from the orchard, we decided it *would well pay.*

I at once went at it, and have now put in seven years' active campaign. The second year we lost 475 trees, the third 165 trees, the fourth 38 trees, the fifth 14 trees, the sixth 1 tree, and the seventh 2 trees, but have worked on and saved hundreds.

This year we have shipped from these forty acres of trees twenty-seven thousand five hundred boxes of pears. In this time we have expended $6,178, or a little more than $154 per acre, besides incidentals, such as disinfecting, tools, sponges, etc.

Some large trees have taken one half a day of hard work on the part of an expert to clean up a single tree.

We keep an expert by the year who goes from tree to tree in the orchard, beginning in the spring at blossoming time and continuing during the whole season, with perhaps the exception of one or two months. His work is the cutting out of every blighted twig, disinfecting the tools after each cut, and when cutting a limb always to examine it to see whether or not he has cut into a blighted portion. If he has done so, he must immediately disinfect his tools and cut again lower down. Sometimes it is necessary to remove limbs as large as your arm, some-

times cut off two or three large limbs, and clean off bark and diseased wood from trunk of tree down to ground, dig around and under tree and cut off one, two, or three large roots. It is imperative that every trace of diseased wood or bark be removed and the cut thoroughly saturated with a solution of corrosive sublimate. Later on it is best to paint the scar with good paint to protect from weather.

This campaign is continued until fall, when every tree in the orchard has the earth carefully taken away from crown and is gouged with a quarter-round chisel. Some large trees we have gouged in as many as

FIG. 13.—Pear tree treated for pear blight. Showing removal of bark, as well as many of the larger limbs. (Original.)

fifty places, for it is impossible to tell whether or not a rough bark tree is free from blight by its appearance on the surface. In our orchard sometimes the blight may be found a quarter of an inch from a previous gouge mark, which was O. K. By this system of gouging it is almost always possible to detect any trace of the disease in crown or trunk. In very large trees we also gouge the large limbs, especially at forks.

In one portion of our orchard were about fifty trees, fifty years old, and near by a young orchard with trees from four to eight years of age. In this young orchard blight kept appearing, and we lost nearly half of the block. At last we discovered a gummy exudate in crotches of the old trees. After much work and repeated inspections we were able to get rid of all blight in old trees, since which time no trouble has appeared in the young orchard.

Warm, damp weather during blossoming time is very favorable to the spread of disease, and on the contrary dry, cold weather is favorable to blight control. This fact has led many successful orchardists to underestimate the seriousness of this scourge. For the past three seasons the weather conditions have been very favorable to blight control, and in our neighborhood not a few, thinking the disease had run its course, have gone to sleep on the picket line. I predict that one warm, moist spring will so aid in the spread of this disease that I would not be surprised to see over half of the pear industry of the State wiped out.

In the way of advice, I would say to one contemplating planting a pear orchard, that unless you are willing to put up a fight from the first season on forever, you had better stay out of the pear-growing business.

I would, also, urge the foolishness of expecting the Japanese or Chinese laborers to act as the experts for exterminating pear blight, as our own experience has proven it inefficient. They will not disinfect after every cut, nor will they cut below infected wood.

As there are many Japanese in our section, I thought it advisable to have all rules for blight control translated into the Japanese language, and had over a thousand copies printed. During one season which was especially favorable to blight, and the disease seemed unusually malignant, I let the Japanese, who were anxious to do the work themselves, help with the cutting under the supervision of two experts, a copy of the printed rules in the hands of each man.

I later found that in nine out of ten limbs on which these men had operated the disease had gone on, showing conclusively that they not only did not disinfect properly, but had failed to cut below the infected wood.

Non-suckering stock is the best relief I believe we can hope to find, as any one at all familiar with the work can cut out plainly diseased limbs, but only an expert is fitted to cope with the root, crown, or trunk trouble coming at these points through the suckers. Partially immune stock, such as Le Conte or Kieffer, I also recommend. These to be reworked into the desired variety. During a malignant blight season,

checking the growth by little pruning, cultivation, irrigation, or fertilization will aid much in holding back the disease, as generally the more thrifty the tree, the more susceptible to the disease. I believe, when water is available for irrigation, it best to seed the orchard to alfalfa, and this, in a way, lessens the danger from plow contagion, as well as through mutilated root suckers.

NOTE.—The importance of this paper leads us to publish it in "The Monthly Bulletin," as well as in the regular proceedings of the convention. *Editor.*

FIG. 14.—Pear tree treated for pear blight. Showing how the infectation started from a single limb, which was removed. The gouge marks are plainly visible on the healthy limbs. (Original.)

NEW STATE QUARANTINE LAW.

That our law makers realize the importance of the great fruit interests of California is shown by the fact that on December 24, 1911, Governor Hiram W. Johnson called a special sesion of the State Legislature to consider the passage of a more adequate state quarantine law. In compliance with this call, a bill was introduced by Mr. Judson and passed both houses within a few minutes after its final reading. It was signed by Governor Johnson January 2, 1911, and repeals the old quarantine law approved March 11, 1899, and is as follows:

An act to provide for the protection of horticulture and to prevent the introduction into this State of insects or diseases, or animals, injurious to fruit or fruit trees, vines, bushes or vegetables, providing for a quarantine for the enforcement of this act, making a violation of the terms of the act a misdemeanor, and providing the penalty therefor; providing that said act shall be an urgency measure and go into effect immediately, and repealing that certain act entitled "An act for the protection of horticulture and to prevent the introduction into this State of insects, or diseases, or animals, injurious to fruit or fruit trees, vines, bushes or vegetables, and to provide for a quarantine for the enforcement of this act," approved March 11, 1899.

The People of the State of California do enact as follows:

SECTION 1. Any person, persons, firm or corporation who shall receive, bring or cause to be brought into the State of California, any nursery stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds or fruit pits, or fruit or vegetables, or seed, shall immediately after the arrival thereof notify the state commissioner of horticulture, or deputy quarantine officer, or quarantine guardian of the district or county in which such nursery stock, or fruit or vegetables or seed are received, of their arrival, and hold the same without unnecessarily moving the same, or placing such articles where they may be harmful, for the immediate inspection of such state commissioner of horticulture, or deputy quarantine officer or guardian. If there is no quarantine guardian or state horticultural quarantine officer in the county where such nursery stock or fruit or vegetable, or seed is received, it shall then be the duty of such person, persons, firm or corporation to notify the state commissioner of horticulture, who shall make immediate arrangements for their inspection. The state commissioner of horticulture, deputy quarantine officer, quarantine guardian or such person or persons as shall be commissioned by the state commissioner of horticulture to make such inspection, or to represent said commissioner, is hereby authorized and empowered to enter at any time into any car, warehouse, depot or upon any ship within the boundaries of the State of California whether in the stream or at the dock, wharf, dock, mole, or any other place where such nursery stock or fruit or vegetables or seed or other described articles are received or in which such nursery stock or fruit or vegetables or seed is imported into the state, for the purpose of making the investigation or examination to ascertain whether such nursery stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds, fruit pits, fruit, vegetables or seed is infested with any species of injurious insects, or their eggs, larvæ or pupæ or other animal or plant disease.

If after such examination or inspection, any of the said described articles are found to be so infested or infected as aforesaid, then it shall be the duty of the owner, owners, or persons, firm or corporation having charge or possession thereof to so disinfect at his or their expense such portion or portions of the ship, dock, wharf, mole, car, warehouse or depot where said articles may have been located in such a manner as to destroy all infection or infestation present or that is liable to be present, and all articles or packages or soils apt to be so infested or infected shall be held until the said articles or packages or soils have been thoroughly disinfected and all injurious insects, or their eggs, larvæ or pupæ or other animal or plant disease have been eradicated and destroyed; *provided, however*, that all articles of nursery stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds, fruit pits, fruits, vegetables or seed which are infested or infected with such species of injurious insects or their eggs, larvæ or pupæ or other animal or plant disease which may be or be liable to be injurious to the orchards, vineyards, gardens or farms within said state, shall be

destroyed or reshipped out of the state as hereinafter provided. The said officer so making such inspection shall not permit any of the described articles so coming in contact with said infested or infected articles or any articles which might convey infection or infestation to be removed or taken from any such car, warehouse, depot, ship, dock, wharf or any other place until such infection or infestation shall have been destroyed.

SEC. 2. Each carload, case, box, package, crate, bale or bundle of trees, shrubs, plants, vines, cuttings, grafts, scions, buds or fruit pits, or fruit or vegetables or seed, imported or brought into this state, shall have plainly and legibly marked thereon in a conspicuous manner and place the name and address of the shipper, owner, or owners or person forwarding or shipping the same, and also the name of the person, firm or corporation to whom the same is forwarded or shipped, or his or its responsible agents, also the name of the country, state or territory where the contents were grown and a statement of the contents therein.

SEC. 3. When any shipment of nursery stock, trees, vines, plants, shrubs, cuttings, grafts, scions, buds, fruit pits or seed or vegetables or fruit, imported or brought into this state, is found infested or infected with any species of injurious insects, or their eggs, larvæ or pupæ or other animal or plant disease or there is reasonable cause to presume that they may be so infested or infected, which would cause damage, or be liable to cause damage, to the orchards, vineyards, gardens or farms of the State of California, or which would be or be liable to be detrimental thereto or to any portion of said state, or to any of the orchards, vineyards, gardens or farms within said state such shipment shall be immediately destroyed by the state commissioner of horticulture, his deputy quarantine officer, quarantine guardians or other person or persons, who shall be commissioned by the state commissioner of horticulture to make such inspection; *provided, however*, that if the nature of the injurious insects, or their eggs, larvæ, pupæ or animal or plant disease be such that no damage or detriment can be caused to the said orchards, vineyards, gardens or farms of California or any of the same by the shipment of the same out of the state, then the said state commissioner of horticulture, his deputy quarantine officer, quarantine guardians or other person or persons who shall be commissioned by the state commissioner of horticulture to make such inspection, and who shall make such inspection, shall notify the owner or person, firm or corporation having possession or control of said articles to ship the same out of the state within forty-eight hours after such notification, and it shall be the duty of such owner or owners, or person, firm or corporation, to so ship said articles, but such shipment shall be under the sole direction and control of the officer so making the inspection and shall be at the expense of the owner or owners, his or their agent or agents, and for a failure to comply with such notice such owner or owners, his or their agent or agents shall be deemed guilty of a violation of the terms of this act and be punished accordingly and immediately after the expiration of the time specified in said notice said articles shall be seized and destroyed by said officer at the expense of the said owner or owners, his or their agent or agents.

SEC. 4. When any shipment of nursery stock, trees, vines, plants, shrubs, cuttings, grafts, scions, fruit, fruit pits, vegetables or seed, or any other horticultural or agricultural product passing through any portion of the State of California in transit, is infested or infected with any species of injurious insects, their eggs, larvæ or pupæ or animal or plant disease, which would cause damage, or be liable to cause damage to the orchards, vineyards, gardens or farms of the State of California, or which would be, or be liable to be, detrimental thereto or to any portion of said state, or to any of the orchards, vineyards, gardens or farms within said state, and there exists danger of dissemination of such insects or disease while such shipment is in transit in the State of California, then such shipment shall be placed within sealed containers, composed of metallic or other material, so that the same can not be broken or opened, or be liable to be broken, or opened, so as to permit any of the said shipment, insects, their eggs, larvæ or pupæ or animal or plant disease to escape from such sealed containers and the said containers shall not be opened while within the State of California.

SEC. 5. No person, persons, firm or corporation shall bring or cause to be brought into the State of California any fruit or vegetable or host plant which is now known to be, or hereafter may become a host plant or host fruit of any species of the fruit fly family *Trypetidæ* from any county, state or district where such species of *Trypetidæ* is known to exist and any such fruit, vegetable, or host plant, together with the container and packing, shall be refused entry and shall be immediately destroyed at the expense of the owner, owners or agents.

SEC. 6. No person, persons, firm or corporation shall bring or cause to be brought

into the State of California any peach, nectarine, or apricot tree or cuttings, grafts, scions, buds or pits of such trees, or any trees budded or grafted upon peach stock or roots that have been in a district where the disease known as "peach yellows" or the contagious disease known as "contagious peach rosette" are known to exist, and any such attempting to land or enter shall be refused entry and shall be destroyed or returned to the point of shipment at the option of the owner, owners or agent, and at his or their expense.

SEC. 7. No person, persons, firm or corporation shall bring or cause to be brought into the State of California any injurious animals known as English or Australian wild rabbit, flying fox, mongoose or any other animal or animals detrimental to horticultural or agricultural interests.

SEC. 8. Any person, persons, firm or corporation violating any of the provisions of this act shall be guilty of a misdemeanor and shall be punished by imprisonment in the county jail for a period not exceeding six months, or by a fine not exceeding five hundred dollars, or by both such fine and imprisonment.

SEC. 9. It is hereby determined and declared that this act and each and all of the provisions thereof, constitute and is an urgency measure necessary for the immediate preservation of the public safety and health. The facts constituting such necessity are as follows: There now exists in various islands and territory in close proximity to the State of California dangerous and injurious fruit and plant diseases and insects and animals, and heretofore fruits, vegetables, plants, seeds and other articles of horticulture and agriculture from said islands and territory have been and now are being shipped and brought into the State of California, which are to a large extent infested and infected with dangerous and injurious fruit and plant diseases and insects, their eggs, larvæ and pupæ, and which if continued to be brought into the state will cause great danger to the public health, and will greatly damage the horticultural and agricultural interests of said state, and will also be detrimental to the public health, and this act is necessary to provide ample power to prevent the introduction of such insects and diseases and injurious animals into the state and to prevent the spread of such disease, insects and animals.

SEC. 10. That certain act entitled "An act for the protection of horticulture, and to prevent the introduction into this state of insects, or diseases, or animals, injurious to fruit or fruit trees, vines, bushes, or vegetables, and to provide for a quarantine for the enforcement of this act," approved March 11, 1899, is hereby repealed.

SEC. 11. This act, being an urgency measure as above set forth, shall take effect and be in full force immediately from and after its passage.

STEM-END ROT AND GUMMOSIS.

By A. J. COOK.

The fruit interests of Florida are so like our own that all horticultural publications from that State possess peculiar value to our orchardists. What adds emphasis to this assertion is the fact that Florida has secured scientists of the very highest ability to investigate and solve her problems. The bulletins from her experiment station and the report of her State Horticultural Society are really classic, and we urge all our growers to secure and study them. The proceedings of the twenty-fourth annual meeting of the State Horticultural Society has just come to hand and possesses rare merit. It is beautifully executed, and is replete with interest and value to all fruit growers. Of special worth to our orchardists is the excellent paper by H. S. Faweett on Stem-End Rot and Gummosis. As Professor Faweett is soon to be our man and to work for us, this paper is doubly interesting to us. He has proved conclusively that both these ailments are of fungous origin, that they are serious pests to the citrus grower, and that they are amenable to control. He induces the disease into healthy fruit or trees by inocula-

tion, and explains the life history of the two fungi that produce the two diseases. The fungi are very minute so they can only be studied by use of the microscope. Stem-end rot is a new disease, but gummosis is an old-timer, though it has not been thought to be fungous in its nature till the hard, thorough work of Professor Fawcett proved it to be so. The minute threads of the fungus (*mycelium*) that cause stem-end rot push into the fruit and cause disease and decay. It reproduces by the formation of spores. The twigs bearing the fruit die back for several inches, show gum, and hold innumerable spores which are found on the dead wood. Sound as well as injured fruit falls victim to this deadly fungus. Sound oranges will contract the disease by contact with the dead spore-bearing twigs or the affected fruit. Unlike blue mold, this fungus will attack sound fruit, though a lesion of the tissue favors its development. Its growth is faster from the threads than from the spores. The control consists in pruning away and burning the dead twigs, and in destroying the diseased fruit. Sprays seem to be impotent to effect a cure or to stay the attack.

It has been supposed that gum disease (gummosis) was a physiological malady, but Professor Fawcett shows conclusively that it is fungoid, and that the same wee plant—the fungus—causes gummosis in both the peach and citrus fruit. The effect of the disease is too familiar to us all: The unctuous gum, bark cracks, roughened ulcerated bark, and finally a serious lesion, which may encircle the entire tree, are familiar to most citrus growers. Often the disease causes death, and when it attacks a wide area, the tree seems to have lost its thrift and value. The specific fungus has been detected and peach and orange have been inoculated, the one from the other. Professor Fawcett also found that the fungus of gummosis would cause a sort of stem-end rot much like the true malady of that name, but really different. It was less likely to attack sound oranges.

Here, again, severe pruning away of the diseased tissue is the best way to control this fungus, known as *Depladia natalensis*. Thus we have three of these serious ailments caused by these microscopic plants which are best controlled by gouging or cutting out all diseased tissue: Pear blight, stem-end rot, and gummosis. It is also suggested that we may prevent these diseases, in part at least, by securing resistant stocks or varieties.

I wish to repeat that in securing the services of Professor Fawcett, California has won a most substantial prize. As Professor Rolf well said, no one can know the hard, long, continual work required to secure these brilliant results brought to light by Professor Fawcett.

A DANGER TO OUR CITRUS BELT.

The Mexican Orange Maggot (Anastrepha (Trypeta) ludens).

By D. L. Crawford, Stanford University.

In the Pomona Journal of Entomology, Vol. II, No. 4 (1910), pages 322–332, there appeared an article on the Mexican Orange Maggot, as based upon certain investigations which I had made while carrying on the work of a biological expedition in various parts of the southern half of Mexico. For the benefit of the California fruit growers and the protection of the great citrus industry against such a pest as the Morelos fruit fly, some of the facts from the paper mentioned above are again brought before the public. The seriousness of the pest, if it should ever become established in our orchards, and the difficulty of eradicating it, are so great that too much attention can not be directed to it.

The range of fruit attacked by this fly is not so great as that which is subject to the ravages of the Mediterranean fruit fly (*Ceratitis capitata*). As far as I could determine, the orange, mango, and guava are the principal fruits in which the so-called Morelos maggots are found. All varieties of oranges and guavas seem to be subject to its attack, but one variety of mango is apparently immune from it. This variety is usually larger than the others, clearer yellow in color, and usually more flattened at the "flower" end.

The eggs are laid beneath the thin outer skin (cuticle or epidermis) of the fruit, and when they hatch the larvæ eat their way into the fruit. As a result of this, the only trace of the presence of the small maggots is a minute puncture through the skin, which is not visible except by magnification and a careful search. As the larva (Fig. 15, *a*) grows and eats its way further into the fruit, its presence becomes more easily detected, especially in the mangoes and guavas. In these fruits the portion attacked softens and rots, and when the spot is pressed a little, juice often comes out from the small puncture from which the work started. In the orange, however, the maggot is detected with more difficulty, owing to its thicker and firmer skin. Most of the work of the maggots in the orange is in the fruit proper rather than in the skin or pulp, and, consequently, the softened and rotten spot caused by the larva is not so easily detected. To one familiar with it, however, the spot is usually visible by a slight change in color and often by a little juice emerging from the puncture.

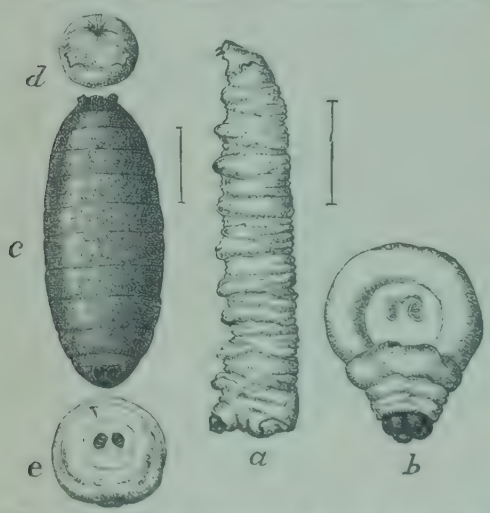

Fig. 15.—The Mexican Orange Maggot (*Anastrepha ludens*); *a*, larva; *b*, anal segment of same; *c*, puparium; *d*, *e*, head and anal segment of same. (After Riley, in Insect Life.)

There may be as many as five, six, or even more, larvæ in the same fruit. After about two weeks the spots become so large and the fruit so decayed that it drops from the tree. The larvæ, when mature, then crawl out of the fallen fruit and work their way into the ground near by or under it, and there transform into the pupæ (Fig. 16, *c*). After about three weeks the adult emerges and comes out of the ground to begin another generation by laying eggs in other fruit.

The seriousnes of its depredations may be seen from the following observations: A typical mango grove in Cuernavaca, State of Morelos, was found by inspection to have about three fourths of its crop infested by the maggots! Another, in poor condition, was even worse. It is very difficult in some parts of Mexico to get a guava free from the maggots. The proportion of oranges attacked is about the same as for

FIG. 16.—Female of the Mexican Orange Maggot (*Anastrepha ludens*). (After Riley, in Insect Life.)

the mangoes—one half, or even three fourths, of the crop being destroyed in some places. What would become of our citrus industry if the fly should work the same havoc as it does to-day in Mexico?

To realize the great difficulty in eradicating a pest of this kind, or even controlling its ravages, we need only consider the Apple Maggot or Railroad Worm in this country (*Rhagoletus* (*Trypeta*) *pomonella*) and the Mediterranean fruit fly and the numerous other fruit flies which to-day are scourges in Australia, Hawaii, the Sea Islands, and many other places. The difficulty lies in the fact that the eggs are buried beneath the skin, and the larvæ work always within the fruit, so that neither can be killed by a spray or a poison. The pupæ are protected doubly—by burial in the ground to a depth of from one fourth to three fourths of an inch, and by a hard pupal case around them. The adults are very hard to kill effectually. To a slight extent this may be accomplished by a poisoning in various ways, but the small percentage killed in this way seems to be of no avail. It is hoped that parasites may be found to assist in the eradication, but at present almost nothing has been accomplished in this direction.

When driven to it, moreover, the fly seems to be able to adapt itself to other fruits, thus increasing the danger tremendously to the fruit grower. Not only is it able to adapt itself to change of food, but also to a change of life habits. In some parts of Mexico, Morelos for instance, the generations are continuous. In other places, however, where the weather is cooler in certain seasons of the year, Oaxaca for instance, the fly comes in bursts, as it were. That is, there seems to be a time when the fly hibernates, probably in pupal form, and appears again at the coming of warmer weather. Such an adaptation as this would easily make it possible for it to exist in California conditions.

The danger, therefore, of its introduction and establishment in our State is real and imminent. In fact, it would be no cause for surprise to learn that it exists to-day in some of our orchards, and has been overlooked simply because of ignorance of the orchardist or inspector as to its appearance.

The principal source of danger is from the bringing of small amounts of Mexican fruits in one's suit case or lunch basket when entering California, Arizona or Texas from Mexico and carelessly throwing away some if it should be found wormy. Another source of danger is from the consignments of fruit from Mexico which traverse California to a destination outside of our State. At present we are unable to touch such fruit, but must stand by and watch it go through our citrus country with the maggots dropping out along the way and the adults flying out to nearby trees. If congress will pass a national quarantine, we will be protected on this score. Quarantine inspection at the ports of entry in California is effective and should prevent its introduction through shipments of fruit to points in the State. It remains, therefore, to urge the traveling public to exercise care in bringing in wormy fruit from Mexico. With the assistance of Texas and Arizona in carrying on a strict inspection at their ports of entry, our citrus industry should be comparatively safe. If these protections, however, can not all be assured, we should again put a quarantine on all Mexican oranges, mangoes and guavas. This extreme method of protection is drastic and works a hardship both on Mexico and ourselves, and should be employed only as a last resort.

Great responsibility rests upon the county commissioners and their inspectors, as well as on the state quarantine officials. Every commissioner and every inspector must surely know the appearance of the adult Morelos fly and its larva, and must report to the State Commissioner of Horticulture the discovery of the fly or maggot, or anything similar to it. The adult fly, Fig. 16, may be very easily recognized by the peculiar marking of the wings, the reddish color of the body, and the long slender tube at the end of the female abdomen. This is often bent down and more or less hidden under the abdomen, but should be easily seen, nevertheless. The fly is a little larger than the house fly. It usually walks about slowly over the fruit or leaves, with the wings held straight out and the abdominal tube moving slowly up and down.

As soon as they are available, a few specimens will be sent to each commissioner in order that he may become familiar with its appearance. It would be an excellent thing, also, if each commissioner could have a few specimens of the more important fruit flies before him.

If the fly already exists in our State we must know it as soon as possible. The sooner we know it the easier it will be to eradicate it before it becomes established. If the inspectors and growers and all concerned will work together and report to headquarters any discovery, and meanwhile exercise great care in bringing in fruit from Mexico, there is little doubt but that we can protect our orchards from the depredations of a pest so serious and deadly as this Morelos worm.

NATIONAL QUARANTINE AND INSPECTION LAW.

By Frederick Maskew.

(Given at the meeting of the Pacific Slope Association of Nurserymen, Los Angeles, California, November 23-24, 1911.)

Do we need a National Quarantine and Inspection Law? That, I believe, to be the substance of the number allotted to me as my share of the program this morning. As a quarantine officer I believe that, speaking for this State, we do need such a measure very much indeed. The horticultural laws of California are admitted to be the most complete and effective measures ever enacted for the protection and promotion of crop production, but the fact still remains that the horticulturists of California are, at the present time, expending a million of dollars annually to simply control the insect pests that are already here, and diligently at work reducing the amount of production and lowering the market value of their crops. Any measure that will increase the protection and augment the insurance that this annual burden is not going to be increased by the introduction of other new and dangerous insect pests and plant diseases, should receive the unanimous support of every one interested in the general welfare of the country.

The State Commission of Horticulture, through its quarantine division, has done yeoman service along these lines, and for nearly twenty years has maintained an efficient inspection at the port of San Francisco of all horticultural products arriving at that point from foreign sources, and with the meager funds at its command for that especial purpose accomplished a great deal more good than it received credit for, not alone in the insect pests and plant diseases it kept out of the State, but in the fact that it set a persistent example, and kept prominently to the front, the value and the necessity of such work on a broader, more general scale throughout the entire country. The quarantine orders and compulsory measures that, as a result of its experience and judgment, it was compelled to issue from time to time in protection to our own horticultural interests have been used as models and put into operation in other states and countries. With legislation in sympathy with its purposes, and an adequate appropriation for its work, it has branched

out, until, at the present time, through the intelligent coöperation of the state quarantine guardians in every county, and the increase in the number of its own deputies, it is in intimate touch with every maritime port on the California coast line, and with practically every distributing point on each of the three great railroad systems traversing the State. Much valuable assistance is being rendered in the matter of foreign importations by the action of the Chief of the Bureau of Entomology at Washington, D. C., who now forwards to the State Quarantine Officer a manifest of every lot of plants passing through the Atlantic customs service en route to California. All of this, complete as it is, is by no means as perfect as the importance and the magnitude of the horticultural interests of California demand.

And now, gentlemen, realizing that the passing of the measure now before Congress will not be accelerated by my standing here rehearsing to you these details, every one of which you, as nurserymen, know just as well as I do, results are not achieved by a simple relation of circumstances, even if they are facts, but by positive, direct action on the part of the entire assemblage, consequently I am going to rest my case and pass it on to the meeting for further discussion, and I hope prompt action on the following statement:

Every quarantine officer in California knows—in fact, it is so constantly on his mind that, as Professor Cook says, "he thinks about it even in church"—that, notwithstanding all this legislation, all this ingenious care and diligence exercised to keep these things out, he knows that there are in California to-day, outside of his jurisdiction out freely available to every man, woman and child in the State, over one thousand seven hundred and fifty avenues of entrance standing with wide open doors through which these pests may pass unchallenged each and every one of the three hundred and sixty-five days in the year.

As a quarantine officer, I believe that these doors can only be closed permanently and these avenues safely guarded by Federal action, and that is one reason why I advocate the passing of a national quarantine and inspection law.

CALIFORNIA STATE LEGISLATURE FAVORS NATIONAL QUARANTINE.

The subject of national quarantine, which has been of such vital importance to the fruit growers of California for many years, has just been endorsed by both houses of the California State Legislature in the following joint resolution:

SENATE JOINT RESOLUTION No. 10.

Relating to the Simmons national quarantine act, now before Congress.

WHEREAS, The State of California is now expending more than one million dollars annually in combating insect foes, one firm having spent more than twenty-five thousand dollars in a single season in the effort to control a single insect pest; and

WHEREAS, We are confident from our recent experiences that a thorough quarantine during all the past of our horticultural history would have saved to our state a

large part of this vast expenditure, as many of the pests now working havoc would not have gained admittance; and

WHEREAS, It is generally conceded that our California quarantine, the best in the country has saved millions of dollars to other states as well as our own, and so is national in its scope, and should be national in its origin and authority; and

WHEREAS, It is imperative that persons and baggage be searched as well as fruits, plants, or seeds, etc., and this can only be done by consent of the government, authorized by congress; and

WHEREAS, We search persons and their effects when we suspect that they carry smuggled diamonds or other illicit valuables, and our fruit interests are of far more value and importance than are diamonds or other precious stones; and

WHEREAS, Insects carried by plants, especially such insects as the gipsy and brown-tail moths and the dreaded Mediterranean fruit fly, if transported across the country from port of entry, as from New York to California, or San Francisco to New England, are liable to escape in transit and thus may work irreparable damage; and

WHEREAS, It is imperative to the success of our agricultural interests that strict quarantine be established and rigidly enforced against any region harboring insect pests; and

WHEREAS, It is of exceeding importance to our agricultural interests to establish quarantine and to quarantine at such points as Nogales and El Paso, and also to search baggage and even persons, which can only be done by national permission and authority; therefore, be it

Resolved by the Senate and Assembly, jointly, That we respectfully urge Congress of the United States to pass the Simmons quarantine bill now before Congress, and to include in such bill a passage making the port of entry and not the point of destination the place of inspection and decision, and also a provision permitting a strict quarantine against any district of the United States or any foreign country where insect pests that threaten the safety and welfare of our agricultural interests are known to exist; and it is further

Resolved, That our Senators be instructed and our Representatives in Congress requested to use all honorable means to secure the passage of the Simmons bill, with the two provisions designated above included in the bill; and it is further

Resolved, That the Governor of California be and is hereby directed to transmit a certified copy of these resolutions to the President and Speaker, respectively, of the Senate and House of Representatives of the Congress of the United States, and to each of our Senators and Representatives in Congress.

HOW TO FIGHT THE PEAR THRIPS.

By G. E. MERRILL.

Distribution. The pear thrips, probably the most serious insect pest that to-day confronts the deciduous fruit growers of our State, is at present generally distributed throughout the fruit growing districts of the Santa Clara Valley, the counties around the San Francisco bay region, and parts of Yolo, San Joaquin, and Sacramento counties. The insect is spreading rapidly, and it is probably only a question of time before it will become generally distributed throughout the deciduous orchards of northern and central California. The pear thrips has also been found in England and in New York state, where it promises to become a serious pest of the pear tree.

Damage. The damage done by the pear thrips is caused by its eating and egg-laying ravages on the tender tissues of the expanding flower and leaf buds, and later by the attacks of the larvæ or "white thrips" on the young fruit. The effect of thrips work on pear buds is shown in Fig. 17. In badly infested orchards, the work of the pest is so quickly and thoroughly done, that the buds have no chance to open. At the time when the blossoms of these orchards should be at the height of their

beauty, a brown, fire-swept appearance is presented, and not until the larvæ have disappeared beneath the surface of the ground do the trees appear in their customary springtime garb of green. Under these conditions practically no fruit is matured. In orchards less badly affected much fruit persists on the trees, but does not come to a normal maturity. In the case of prunes and plums a large percentage of the fruit will present a scabbed appearance when matured. With pears the fruit may be scabbed and curled or otherwise badly deformed. Although the pear thrips attacks nearly all of the deciduous fruits, most of its damage is done to prunes, pears and cherries. There are but few cases on record

FIG. 17.—Thrips injury to buds of Bartlett pear.
Courtesy U. S. Department of Agriculture.

of serious damage to peaches, apricots or almonds. The hairy surface of these last named fruits seems to protect them to a certain extent from the voracious appetites and injurious egg-laying habits of the species.

The amount of damage done by the pear thrips during the past seven years has been conservatively estimated by agents of the United States Department of Agriculture at seven millions of dollars. In this estimate no account is taken of the cost of spraying operations and other means exercised for the control of this insect.

Life history. Before any insect pest can be fought intelligently, the knowledge of its life history is of prime importance. Early in the spring, just when the buds are beginning to swell, the adult thrips make their first appearance on the twigs and buds. In the Santa Clara Valley the thrips are usually first noticed about the middle of February. From the time of their first appearance the number of adult thrips in evidence

rapidly increases until late February or early March, when a rapid decrease is noted. However, the latest thrips may not leave the ground until early April. As many as 400 individuals have been taken at one time from a single cluster bud of cherries or prunes. From 50 to 100 thrips per bud are frequently present throughout a badly infested orchard. By the time the scales on the buds have separated enough for the thrips to squeeze in, in they go, to feed on and otherwise to injure the tender tissue within.

Views of the mouth-parts and ovipositor of an adult thrips are shown in Figs. 18 and 19. Just as soon as an entrance is forced into the bud, the insect begins to feed. Now, thrips do not bite off and chew their food, instead they rasp an opening through the skin of the leaf or

FIG. 18.—The pear thrips (*Euthrips pyri*); head and prothorax from side, to show mouth-parts. Much enlarged. (U. S. Dept. Agrcl.)

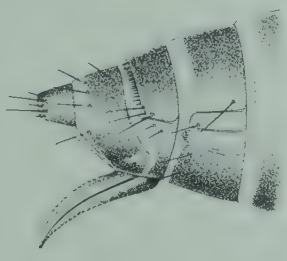

FIG. 19.—The pear thrips (*Euthrips pyri*); ovipositor and end of abdomen from side. Much enlarged. (U. S. Dept. Agrcl.)

blossom tissue, insert their beaks and partake of the life juices of the plant. After a few hearty meals, the thrips are ready to begin another branch of their life activity, that of egg-laying. To lay an egg a thrips rasps a hole through the skin of the tender plant tissues with her saw-life ovipositor, which is then inserted in the opening as deeply as possible. An egg is then passed through the ovipositor and imbedded in the growing tissue. A great deal of the damage caused by thrips is due to the effects of oviposition, especially in the case of cherries and other fruits with long, tender stems. A few thrips' eggs placed in a cherry stem will so weaken it that the fruit is caused to drop. From 25 to 50 eggs per thrips are laid during the active adult stage of three or four weeks' duration.

The eggs themselves are small, bean-shaped objects, from which the young thrips, the so-called "white thrips," emerge in from four to fifteen days. Usually about eight days are required. The larvæ feed on the blossoms, opening buds and young fruit in much the same way as the adults. They increase rapidly in size, and at the end of three weeks they become full grown and fall to the ground. Here they penetrate the soft layers of soil and enter the compact sub-soil or plow pan, to the depth of three or four inches. The depth at which the larvæ come to rest depends largely upon soil conditions. In loose, sandy or gravelly

soil a depth of two or three feet is sometimes attained, but in the heavier, more compact soil the majority of the thrips are found within 12 or 14 inches of the surface. As soon as the thrips have come to rest, they form little cells about themselves and remain quiescent throughout the rest of their larval and pupal stages. Pupation takes place in September, and pupæ are most abundant in the ground during October and November. Throughout the latter months, and in December, the pupæ transform to adults, which gradually become more active as the season advances, until they are ready to emerge at the first indication of spring. The number of adult thrips per square foot of soil varies, of course, with the intensity of the infestation. As many as 4,000 thrips per square foot have been taken from badly infested ground. From 200 to 500 thrips per square foot are enough to create a serious amount of injury.

CONTROL METHODS.

The control of the pear thrips was one of the most difficult problems ever presented to economic entomologists for solution. Ever since 1905, a large part of the time of from one to seven experts of the United States Department of Agriculture, besides the time of several other economic entomologists, has been devoted to a study of this pest and the means of controlling it. As a result of the work of these investigators have come two methods of control, or rather, spray formulas: (1) The government formula, (2) the lime spray, both of which seem to give good results under certain conditions.

In the early experiments of the department, a large number of different insecticides were tried out. All poison sprays were failures, because of the peculiar feeding methods of the thrips. Sticky sprays were difficult of application, and did not long retain their sticky character after application. Dust sprays failed to kill. Sprays, whose insecticidal properties depended on caustic soda, carbolic acid and other caustic materials, were a success in so far as killing the thrips went, but their use was inhibited because of their harmful effects on the blossoms, foliage, and fruit. Distillate oil emulsions, when sufficiently strong, were efficient in killing the thrips. They also injured the foliage. Early in the work the efficiency of various tobacco washes was noted, but the insecticidal powers of these washes was soon dissipated by evaporation and, at best, they lacked the quality of penetration, that is, to force them into the expanding buds was difficult. Finally came the idea of combining a weak distillate oil emulsion and a tobacco wash. From this idea was developed the government formula, which is to-day giving good success when applied in the right way.

Government formula. The formula which has given the best results is made up of the 3 per cent Distillate Oil Emulsion, to which is added from 1 per cent to 1⅝ per cent of Tobacco Extract No. 1 (black leaf containing 2.75 per cent nicotine) or Tobacco Extract No. 2 (sulphate of nicotine or black leaf 40), which is 40 per cent nicotine, at the rate of one part to from 1,500 to 2,000 parts of the spray mixture. The Dis-

tillate Oil Emulsion may be obtained from several dealers in chemical and spraying supplies, or may be made at home. By the use of the home-made emulsion, a considerable proportion of the cost of spraying is saved, and, what is more important, the quality of the emulsion is above reproach, when good materials are properly used in its manufacture. The stock emulsion can be made several weeks previous to the time of spraying, if necessary. The first step in the manufacture of the emulsion is the making of the soap according to the following formula, which will give, when properly made, about 40 pounds of fairly firm soap.

Water	6 gallons
Lye	2 pounds
Fish oil	1½ gallons

To make the soap: Place the water in the kettle or cauldron and add the lye. When the lye has been dissolved and the water is boiling hot, add the fish oil. Boil the mixture gently for one and one half or two hours, or until it presents a ropy, stringy effect when allowed to drip from the ladle. One of the secrets of success in the making of this soap is the use of the genuine fish or whale oil. A mixture of fish and mineral oil will not do. This fact should be impressed on the mind of the dealer from whom the oil is purchased, so that no attempt at substitution will be made. With oil at 35 cents per gallon, the cost of the soap should be about one and two third cents per pound.

Distillate oil stock emulsion. To make the distillate oil stock emulsion, the following formula or some multiple thereof is used:

Hot water	12 gallons
Fish or whale oil soap	30 pounds
Distillate oil	20 pounds

No one should attempt to make this emulsion without the use of a power sprayer with a good agitator. For a two-hundred gallon tank, five times the amount of ingredients named above are necessary, if a full 200 gallons of stock is to be made. The water should be boiling hot when put into the tank. As soon as the water is in, the agitator must be started and the soap immediately added. Just as soon as the soap is dissolved, the oil must be slowly added, in the meantime keeping the agitator at work. After the oil is well mixed with the soap and water, the contents of the tank should be passed through the nozzles at a good pressure (175 to 200 pounds) into storage tanks or barrels. The passage through the nozzles is very essential for the securing of a good emulsion. Other essential points are; reasonably exact measurements, boiling heat for the water, and the right kind of distillate. In fact, good results in the orchard depend absolutely on the quality of the distillate. The oil used should test 32° to 34° (Baumé) and should be the raw, untreated distillate, comparatively free from naphtha and with a high flash point. Indeed, the best results are derived from the use of a raw, short-cut distillate, that is, a distillate from which the lighter hydrocarbons, gasoline, naphtha, etc., have been removed. Oils of this

character are put out, particularly by some of the Bakersfield and Coalinga oil companies.

Where the water is unusually hard, the use of caustic soda or more soap than the formula calls for may be necessary in order to soften it.

The stock emulsion made according to the foregoing formula contains about 55 per cent of oil, and should cost the maker about 5 cents per gallon. To make a 3 per cent emulsion for use in the orchard, about 5½ gallons of stock emulsion should be used for each 100-gallon tank. The stock emulsion should be first placed in the tank, and the water should be added under constant agitation. The tobacco extract should be the last ingredient added to the mixture. Owing probably to the different climatic conditions, the use of a larger amount of tobacco extract is necessary in the interior valleys than in the Santa Clara Valley. In the interior valleys Extract No. 1 should be used at the rate of one part to 60. No. 2 is used at the rate of one part to 1,500, or a little more than a pint of the extract to a 200-gallon tank full of spray mixture. In the Santa Clara Valley good results are secured by the use of smaller amounts. No. 1 may be diluted 1 to 75, and No. 2, 1 to 2,000.

Treatment advocated. Where the orchards are badly infested, but three applications are necessary except in the case of pear orchards, where more than three applications may be advisable. The first two treatments are for the adult, the second for the larvæ. The first application should be made just as the thrips begin to enter the separating buds. In this treatment, as in all others, a rather coarse driving spray should be used at a pressure of not less than 175 pounds to the square inch. Particular pains should be taken to shoot the spray into the expanding buds. To do this the nozzle must be held rather closer than usual to the twigs and buds. Except with very small trees, a tower on the spray outfit and a third lead of hose are absolutely necessary.

The second application should be made from four to ten days later when the tips of the petals begin to appear. This treatment should be made in the same thorough manner as the first. The third treatment for the larvæ should be made after the petals have fallen, and particular pains should be taken to reach the under side of the young leaves before the upper sides are touched. If the upper side is hit first by the spray, the larger part of the larvæ will be knocked to the ground without coming in contact with the spray. A somewhat finer spray may be used in this treatment than in the first two. So far as possible, spraying when the trees are in full bloom should be avoided.

The treatment outlined in the foregoing is particularly applicable to prunes, cherries, and pears when the bloom is fairly uniform in its development. In orchards where the bloom is irregular in making its appearance or is spread over a long time, some modifications in the outlined schedule may be necessary; that is, more spraying may be required, or it may be impossible not to spray when some of the bloom is in evidence.

Good results from this treatment have been obtained upon cherries, pears, and prunes. However, the pest is more difficult to control on pears than on prunes, and on prunes than on cherries.

Demonstration results. Early in the government investigations, the fact became plain to the men in charge of the work that not all the shortage in the Santa Clara Valley was due to the thrips. A poor physical condition of the trees, caused by a lack of plant food or water, was responsible for much of the damage laid by some to the thrips. The ravages of the thrips were also more pronounced on these poorly-nourished trees. Accordingly, the application of fertilizers to some of the thrips-infested orchards seemed desirable. Such applications were made in much of the demonstration work in the Santa Clara Valley.

The writer of this paper is greatly indebted to Paul R. Jones of the United States Department of Agriculture for the following facts and figures relating to the demonstration work for the season of 1911: In connection with this work it is only fair to state that the thrips conditions in the Santa Clara Valley this year were not as bad as in some previous years. This state of affairs may be accounted for by the heavy rains at blossoming time in 1910, which probably washed many immature thrips to the ground, where they undoubtedly perished, and by the abnormally dry fall, which may have interfered with the proper development of the insect at the time of pupation and change to the adult form. In consequence of these conditions, the results of the demonstrations here detailed may not be so pronounced as they would have been had the thrips infestations been as severe as was anticipated.

In the prune orchard of Mr. H. Curry three plots were laid off. Plot No. 1 was sprayed twice and fertilized. Plot No. 2 was sprayed twice. Plot No. 3 received no treatment. The cost of the two spray applications was $12.96 per acre and $20 of fertilizer per acre was used on plot 1. The yield of this plot was at the rate of 635 boxes of green prunes per acre. Making proper allowance for shrinkage in curing and figuring on a 5.75-cent-basis price per pound for the dried fruit, the product of this plot was worth $513 per acre. The yield from plot 2, sprayed only, was 593 boxes per acre, worth $471; from plot 3 the check 486 boxes per acre were obtained, valued at $391.05. The gain due to spraying in plot 2 was $67 per acre, and on plot 1, after making allowance for the $20 worth of fertilizer used, $89. The foregoing figures may not seem very impressive, but it should be remembered that the effect of the treatment is cumulative and that next year the sprayed portion of Mr. Curry's orchard ought to be comparatively free from thrips. On the other hand, the unsprayed portion will probably be badly affected, unles all signs of an abundant crop of thrips next year fail.

Mr. Fellows of the Quito ranch is also an earnest believer in the efficacy of the spray in his prune orchard. During the past season he sprayed his entire prune orchard of 250 acres twice and 195 acres of it

three times. The total cost of his spraying operations on 195 acres was $2,577.82, divided as follows:

Labor, 235 days, $2 per day	$470 00
Horses, 210 days, $1 per horse	210 00
Commercial emulsion, 89½ barrels, $6.10 per barrel	581 75
Black leaf, 55½ 5-gallon cans at 90 cents	249 75
Black head, 40, 45 2/10 at $12.50 per gallon	565 00
Gasoline, 144 gallons at 15½ cents	22 32
Lubricating oil, 20 gallons at 45 cents	9 00
Cartage	45 00
Interest and depreciation of outfit	425 00

The Black Leaf was used at the rate of 1 to 100; Black Leaf 40, used at the rate of 1 to 2,000. There were 90 trees to the acre. Each application cost nearly 5 cents per tree, or about $13.50 per acre, for the season's spraying of three applications. The yield of the 195 acres for the year 1910 was 44,276 pounds of green fruit, a large part of which was scabby. The yield from the same 195 acres in 1911 was 1,296,035 pounds of green fruit of good quality. Figured on a 5-cent basis and making an allowance of 2½ to 1 for shrinkage in drying, the 1910 crop was worth $11,813.49, or about $60 per acre. The 1911 crop was worth $34,452.00, or $176 per acre. Mr. Fellows attributes this net gain of $100 per acre almost entirely to spraying. He is going to purchase two more spray outfits, making six in all, so that, if necessary, he will be able to make timely applications on the entire orchard the coming spring.

Even more decisive results can be shown on pears in Santa Clara County.

Mr. T. W. Dean, Courtland, California, is another grower who has made use of the government formula. He made good, thorough applications on pears, peaches, plums and cherries. He does not fear the pests in plums, peaches or cherries, and is confident that he can control it on the pears when the buds open uniformly. He notes that his crop from the tops of the pear trees (he did not have a tower on his spray outfit) was inferior in quality and quantity to that of the lower limb, which received a thorough application of the spray. Instances of the sort given in the foregoing could be multiplied indefinitely. In this connection, however, it is only fair to state that some men who have sprayed conscientiously and thoroughly have not obtained the desired results during the past season, particularly on pears. However, these individuals and others should bear in mind that the results are cumulative, and that another year of spraying will probably place the pest under control.

Lime Spray. Mr. Morris, the county horticultural commissioner of Santa Clara County, reports that he has had excellent results on pears with a simple whitewash spray. His solution is made by slaking lime in water, using as concentrated a solution as it is possible to apply, from 75 to 100 pounds of lime to each 100 gallons of water. Care should be taken to secure first-class lime and to slake it well. The cost of this spray, all made up, should not exceed one cent per gallon. The spray

should be applied just as the buds begin to separate and the entire surface of the tree should be covered. One application is sufficient.

Although Mr. Morris gives no exact statement of the results, he assured me that eight times as many pears per tree were taken from the sprayed trees as from the unsprayed trees.

Summary. If your orchard is infested you ought to spray early, thoroughly and late. The results the first year may not be decisive, but at the end of two years of intelligent spraying the pest will be under control.

"THE FIRST INSECT PEST"

(According to written history, by EDW. K. CARNES, Superintendent of State Insectary).

Some time ago a profound thinker, who is evidently from the East, during a visit to the State Insectary, said, "You western entomologists are certainly making great progress in applying your science, and you toy gracefully with the term 'Insect Pest,' but can you tell me where the first insect pest came from?" and I gave him a brief epitome of written history covering his query.

He said, "You ought to write that down," and it is at his suggestion that I offer the following, which I hope may be of use to our brother officers in the various counties in case the same question is presented to them:

The earliest mention I can find in history of insects in sufficient numbers to be troublesome occurs in the second book of the Bible, for it is written in the eighth chapter of Exodus and the 21st verse: "Behold I will send swarms of flies upon thee." In the 24th verse it is written, "and the land was corrupted by reason of the swarm of flies."

In the biblical footnotes, "swarms of flies" translated means a mixture of noisome insects. In the 31st verse of the same chapter we also find the following: "The Lord removed the swarms of flies; there remained not one." Therefore, if not one remained, we must look farther for the origin of the first insect pest.

Turning to the records of history and by a careful search, no mention worthy of note will be found till the last half of the last century before Christ, when the Latin poet Virgil, in his Bucolics and Georgics, mentions the "blights" that devastated the fields, but does not clearly set forth insect pests.

Next, in the first century A. D. the elder Pliny, the greatest naturalist of his time, really started entomological work by dividing all insects into two classes: the *Coccids* (those preyed upon) and the *Coccinellidæ*, or predaceous insects, our ladybirds of to-day. Those preyed upon were not mentioned as "pests," and the fact that all insects were simply divided by "those preyed upon" and "predators," with no mention here of the former being injurious or pests, would show that the beneficial forms originally controlled those forms that later become "pests" by being removed from the restraining influence of their natural

enemies. Also later in the eighteenth century, when Linnæus gave us the first real classifications of insects, he makes no mention of "insect pests," nor does the written history of Europe or Asia, through all the succeeding years, contain any mention of insects destructive to fruits or grain.

The first mention of "insect pests" we find about the year 1783, and, according to history, the general supposition is that the first insect pest originated in the following manner:

On July 30, 1768, Captain James Cook, in the ship "Endeavor," under the favor of King George III, and under the auspices of the Royal Society of England, sailed from Plymouth harbor accompanied by Sir Joseph Banks, president of the above society, with Dr. Solander, an adept in natural history, bound for Tahiti to observe the transit of Venus, which was to occur in June, 1769. In November, 1769, this expedition reached Australia. In a compilation by Charles R. Lowe, on pages 19, 28 and 76, we learn that Mr. Banks and Dr. Solander went ashore in Australia, and during the three trips inland they collected and brought aboard ship about four hundred species of plants that were new to science. On page 86, of the same compilation, we find "the name of Botany Bay was given to this place, from the great number of plants collected."

These plants were taken to England, arriving April 19, 1770, and were then distributed to southern Europe and the western shores of Asia.

It is a well understood fact that destructive insects, in most cases, are firmly attached to their host plants, and the beneficial forms are the loose flying forms. The very act of digging these plants in Australia shook off the beneficial forms, and the destructive forms were carried with the plants on board.

Some twelve years after this voyage, the pests thus introduced had spread over states and countries of the old world, and history first records the presence of "insect pests" destroying orchards and vineyards.

Practically this same procedure was continually repeated for many years, and no attempt was made to stop it, probably due to the fact that insects, as pests, had not been seriously considered, relative to horticulture and agriculture.

Comparatively speaking, only a few years ago did our own State wake up to the fact that we were allowing insects to be introduced without restriction, and horticultural legislation was enacted to protect us from further infestation, but not until many of the insects that to-day constitute our greatest expense in connection with the production of fruit had been introduced and become established.

GENERAL NOTES.

To keep our readers informed concerning points of general interest regarding new discoveries of beneficial and injurious pests, fungi, insects, weeds, and noxious animals as well as all measures of control, this department is being made one of the best in the publication. Information from all sources will be gladly received, and we hereby solicit your aid.

POISONING INSECTS.

Professor Woodworth made an interesting statement to the writer a few days since to the effect that in poisoning the Argentine ant by use of the arsenites we must use a mild dosage, else the worker ants were quickly killed and the poison did not reach the queen and larvæ. While if a dilute mixture was used, the workers would be able to carry it to the nest and all, including queen and larvæ, would be killed.

This reminds me of an experience in Michigan years ago. The fruit trees were sprayed with the paris green mixture of maximum strength while in full bloom. The weather was fine, and the bees were rampant in their eagerness to secure the nectar. The loss of bees as a result was fearful. Not only were the worker bees poisoned by the millions, but queen and larvæ were likewise victims to this wholesale slaughter.

The moral is plain, never spray the orchard while in bloom. Wait till the blossoms have largely fallen. This course is not only urged because of safety to the bees, but likewise for the best interests of the orchardist, as the codling moth does not lay eggs till this time, and so, if spraying is delayed, the poison will not have been removed by wind or rain to the extent that would be true if applied at an earlier date. Every grower of apples and pears should spray to protect from the codling moth larvæ. This pays big and helps to control a serious pest, but no one should spray until the blossoms have all or nearly all fallen from the tree, as this is the best time to effect results, and does not endanger those good friends of the fruit grower, the honey bees.—A. J. Cook.

POTATO EELWORM.

(Heterodera radicicola.)

By E. O. Essig.

In all previous publications from this office the scientific name of the nematode worm attacking potatoes grown in the state of Nevada has been *Tylenchus devastatrix*.

Recent authoritative determinations from the Bureau of Plant Industry, U. S. Department of Agriculture, give the name as *Heterodera radicicola*. Therefore I wish to call attention to the fact that wherever *Tylenchus devastatrix* is referred to in bulletins, orders, and all publications of the California State Commission of Horticulture, and especially in my own article on "The Potato Eelworm," in "The

Monthly Bulletin," Volume I, pages 26-30, the name *Heterodera radicicola* should have been used.

The following quarantine order has been recently issued by the State Commissioner of Horticulture:

QUARANTINE ORDER, NO. 7.

December 23, 1911.

WHEREAS, We have reason to believe that several districts, more or less restricted in area, in the three counties of Nevada, viz., Lyon, Churchill, and Washoe, which, on November 27, 1911, were quarantined against the potato eelworm, are free from this pest and ought not, in justice to the growers and to our people as well, be denied entrance to California; and

WHEREAS, It is impossible to exclude said districts from the quarantine; therefore,

Resolved, That we declare the said quarantine revoked and permit all potatoes from Nevada to enter this State, but all such potatoes must be carefully inspected upon arrival, and if a single potato is found to harbor the eelworm, the entire car will be ordered out of the State, or destroyed at the option of the shipper.

(Signed) A. J. COOK,
State Commissioner of Horticulture.

Approved: HIRAM W. JOHNSON,
Governor of State of California.

THE WHITE FLY WORK AT MARYSVILLE.

By G. E. MERRILL.

Since our last writing on the white fly the planned-for work at Marysville has been completed. The treatment consisted in the application of a caustic spray to the common host plants of *Aleyrodes citri* throughout the infested territory. A spray of this character was used with the intention of defoliating the infested citrus trees and other infested host plants. The insect at the time of the application was in the larval stage, and it was thought that practically none of the pest would survive if the foliage was dropped.

The spray used was made up of a mixture of distillate 5 per cent and water 95 per cent to each 100 gallons, of which 6 pounds of caustic soda had been added. The citrus trees and ivy and privet hedges throughout the infested territory on 45 town lots were sprayed. About 415 trees and 20 hedges were treated in all. The application was made with a Bean power sprayer at a pressure of 180 to 200 pounds per square inch under the supervision of the writer and Mr. Geo. Harney, the county horticultural commissioner of Yuba County. A thorough job was done, both upper and under sides of the leaves being treated as far as possible. An attempt was made to spray all plants on which there was any reasonable possibility of the presence of the larvæ of the white fly, as well as, of course, those on which the pest had been actually demonstrated.

At this writing, the desired defoliating effect is not manifest. Owing, doubtless, to the fact that the trees were in a dormant condition, a consideration that was not taken into account in the original plans, the action of the spray has not been what was hoped for. However, the larger part of the white fly larvæ present must have perished from the direct action of the spray, thus materially diminishing the possibility of the spread of the insect.

AN ERROR CORRECTED.

In the previous issue of the bulletin the statement was made that an infestation of *Aleyrodes citri* was discovered at Stockdale in 1907. Since this statement was made, the maker has learned that the insect found there was *Aleyrodes nubifera*, an insect whose general character and importance as a pest is markedly similar to *Aleyrodes citri*.

A VALUABLE BULLETIN.

Bulletin No. 218 by Ralph E. Smith and Elizabeth Smith, and sent out by our College of Agriculture, Berkeley, is a most timely publication. The title is "California Plant Diseases." The first part is an able discussion of the relation of soil and climate to plants, and dwells upon such untoward conditions and cultural practices as tend to make plants unhealthy. He suggests methods to correct the evils. The balance of the bulletin, more than 100 pages, is really a manual, and discusses the several diseases of our cultivated plants and trees, not including insect attack, considering each tree or plant separately. We note that his view of crown-gall and root-knot is the same as that given by us in this month's bulletin.

In one respect we differ with Professor Smith slightly. He seems to teach that fungoid diseases, like "wither tip" do little harm, but only act as saprophytes, attacking only dead or diseased trees and plants. While we believe that the diseased tree is more susceptible to fungoid attack, we also feel sure that the stoutest often fall prey to these insidious foes. Mr. Blanchard's splendid citrus orchard at Santa Paula was a marvel of vigor, but fell victim to the wither tip fungus and suffered seriously. It quickly revived when treated with the Bordeaux mixture. The most vigorous and apparently healthy pear trees will wither almost in a night, before the ravages of the terrible pear blight. All our horticultural commisisoners and inspectors, and all our growers, should procure this manual and thoroughly study it. Its many fine illustrations will aid greatly to make it the more valuable.

A. J. Cook.

CITRUS FRUIT INSECTS.

Bulletin 214 by H. J. Quayle, College of Agriculture, Berkeley, should be in the possession of all interested in citrus fruits. It is very complete, fully illustrated, and contains about 70 pages. It is replete with the latest and best regarding insect control in the citrus orchards. I should hardly agree with the statement that the black scale (*Saissetia oleae*) did no other harm than to smut the trees and fruit. I believe all scale insects, when abundant, are serious drains upon the vigor of the trees. Again, I wonder at the statement that red scale (*Chrysomphalus aurantii*) is only found on the citrus trees. I have known it so thick on castor bean that one could hardly see the plant. Roses suffer severely, and many other plants are victims to its sucking propensities.

A. J. Cook.

CROWN GALL AND ROOT KNOT.

By A. J. Cook.

These two plant ills are very different in nature, appearance and generally in their location. Yet from inquiries received at this office, I am persuaded that this difference is not always appreciated by our county commissioners and inspectors. A gentleman, usually quite correct, remarked a few days ago to the writer, that Dr. Erwin Smith said that these two diseases were one and the same. This, I think, must be incorrect, as Dr. Smith is one of our most able scientists and as a mycologist is very cautious.

Toumey and others have shown that crown gall, which is usually a hypertrophied growth, rough and often large, just at the crown of the trees, is contagious, and he and others have shown that it is easily inoculated from a diesased tree to a healthy one, and so is a bacterial affection. The specific bacterium is *Pseudomonas tumefaciens*. As this is caused by a micro-organism, our county horticultural commissioners should never allow young trees affected with this ailment to be sold by any nurseryman, or to be planted in the orchards of their county. While this crown gall, as its name implies, is usually just at the surface of the earth, it may be and rarely is a little above the ground, and may be beneath the surface of the soil and even on the main roots. It is well for the county commissioner to possess Duggar's work on Fungi and Blights. Its cost is but $2.25, and it is published by Country Life Publishing Company. This work is non-technical, reliable, practical, and is just the treatise for the county horticultural commissioner.

The root knot is quite different in its origin, appearance and location. The roots and rootlets are knotted, and may look beaded throughout their length. Thus, these growths are smaller and numerous, are on the roots, and beneath the surface of the earth, and always below the crown of the tree. While the crown gall attacks for the most part only rosaceous plants, the root knot is a serious pest to some 400 native species of many different orders. Root knot is caused by an eelworm, *Heterodera radicicola*, the potato eelworm. As we would keep out potato eelworms from our soil by never permitting affected tubers to enter the State, so we should always refuse to admit any nursery stock infested with root knot. Prof. E. A. Bessey of the Michigan Agricultural College has just given us a very thorough work on root knot, issued by the U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 217. This should be in the library of every county commissioner. It is very readable and quite up to date.

MELON APHIS.

In the twenty-fourth annual report of the Nebraska Experiment Station, which all of our county commissioners should secure, occurs a valuable paper on the Melon Aphis (*Aphis gossypii*) by M. H. Swenk.

As this aphid works havoc in our own melon fields, this article is of special interest to us here. In Nebraska the loss to the melon crop was often total.

Mr. Swenk finds that this plant louse sucks the sap and life from nearly a score of plants, mostly weeds. In speaking of the natural enemies, Mr. Swenk says that *Hippodamia convergens*, our most common ladybird beetle, is the most abundant and beneficial enemy of this melon aphid. He enumerates several predaceous and parasitic insects that aid to control this pest of the melon grower. He finds a Braconid fly parasite doing wonderfully effective service in reducing the number of this aphid. Mr. Swenk tried several sprays in his work of combating this pest. Usually a remedy that was effective would utterly destroy the tender plants. His one spray that was satisfactory was the soap-tobacco spray, made as follows: Two and one half (2½) pounds of soap were dissolved in one gallon of water, and to this was added one quart of strong tobacco decoction, and all was boiled for five minutes. To this enough water was added to make five gallons. Various combinations of soap and tobacco decoction were used, but the above formula was most effective to destroy the aphid and did little damage to the tender plants.

A. J. Cook.

STATE-WIDE NURSERY INSPECTION.

By G. E. Merrill.

Generally speaking, California has a right to be proud of her nurseries and nurserymen. Taken as a whole, the nurseries are in a good condition, and the nurserymen upright and honorable. There are, however, some nurseries the condition of which can surely be improved. To better these conditions, and by so doing to aid both the nurserymen and the fruit grower, the following letter has been mailed to as many of our nurserymen and nursery stock salesmen as it was possible to reach:

Dear Sir: For some time the State Commissioner of Horticulture has realized that many of the nurseries scattered throughout the State are affected to a greater or less degree with injurious insects and plant diseases. Such conditions ought not to exist in this, the foremost horticultural state of the Union, and it is the intention of the State Commission of Horticulture to aid in correcting these conditions as far as possible.

In order that all may be treated alike, and acting in the belief that more can be accomplished through education than by force, we are sending a copy of this letter (so far as we are able to do so) to each nurseryman in the State, so that he may take such steps as may be necessary to rid his nursery of insect pests and plant diseases before his grounds are inspected by deputies from this office or other authorized inspectors.

As the law now stands, there is practically no difference between the treatment of pests already established in the State and those not so established. Both classes of pests are alike inimical to the horticultural interests, and both alike ought to be extirpated. In the matter of the enforcement of the law, the ultimate interests of both the grower and the nurseryman are the same. Under the law, it is the duty of the State Commissioner of Horticulture, who is also the State Quarantine Officer, and the Quarantine Guardians, of whom there is one in each county, to declare and enforce a rigid quarantine on any infested orchard or nursery.

With the quarantine order in force against it, a nursery would be absolutely power

less to move any of its stock. The State Commissioner does not desire to be forced to bring about this condition in any nursery, but, unless the infested nurseries are made clean, he will have no other course of action.

Trusting that we may obtain your hearty coöperation in our attempt to prevent the spread of injurious insects and plant diseases, we remain,

Yours very truly,

A. J. Cook.
State Commissioner of Horticulture.

The county horticultural commissioners were also furnished with copies of this letter and their coöperation secured for a vigorous prosecution of the work. In fact, the larger part of this work must necessarily be carried on by the county horticultural commissioners and their inspectors, as there are no funds of the State Commission of Horticulture at present available for such work.

Persons who are contemplating the purchase of nursery stock should thoroughly investigate the stock which they are to purchase and the nurseries from whom it is to be purchased. So far as possible, they should deal only with nurserymen of established reputation and who will be in business when the trees they sell come into bearing. In all cases, written guarantees that the stock is true to name should be obtained. With the guarantee in hand, the buyer is in a position to bring suit in after years should the fruit not prove to be the variety named in the guarantee.

A BACTERIAL GUMMOSIS OF CHERRIES.

Cherry gummosis is common to every western cherry orchardist, since it is found in practically all cherry-growing sections on the Pacific coast.

The cause of this disease has long been attributed to purely physiological conditions, the exact nature of which was not known.

It is interesting to note that Mr. F. L. Griffen, of the Oregon Experiment Station, Corvallis, Oregon, has recently discovered that at least one form of the gumming is caused by a specific organism, a bacterium which he has named *Pseudomonus cerasus*,—a description of which was published in Science, Volume XXXIV, November, 1911, pages 615, 616. Regarding methods of controlling this disease, Mr. Griffen makes the following statements:

"The manner of infection and method of prevention is yet to be worked out. Ordinarily, the fruit spur blight is not serious or abundant enough to justify cutting out, but if the generalized form of gummosis should prove to be of a similar specific origin, systematic cutting out, sterilizing of the wounds and burning of the diseased cuttings would be necessary."

"Cherry trees weakened through gummosis fall easy prey to various saprophytic fungi, *Schizophyllum commune*, *Polyporus* sp. and *Polystictus* sp. being the most common. One of the imperfect fungi, which appears very frequently in the gummosis cankers, but whose identity has not been fully determined may prove to be at least semi-parasitic in nature."

"The growers have found by experience that top-working, resistent stocks will to a great extent prevent the disease from appearing on the body or crotch of the tree. The Mazzard seedling is most often used for this purpose, although the Morello, Duke and a native western cherry have been successfully utilized. The method is to plant the seedling in the orchard in the usual manner and then top work the branches, preferably by budding at least twelve inches above the crotch, when the trees are two or three years old. This eliminates the gummosis factor from the trunk and crotch, but the disease may later affect the fruit-bearing wood."

"The Royal Anne, Bing and Lambert, which are the principal commercial varieties, are susceptible to gummosis, the Lambert being the most resistant."

In connection with this study it is also interesting to note that Mr. H. S. Fawcett of the Florida Experiment Station has discovered that a form of the gummosis of citrus trees is caused by an organism similar to the one described by Mr. Griffen.

In a Review on Gummosis by Dr. Cook, in another article, this discovery is treated more fully.

Such work shows how much there is still to learn, and points out the value of close, careful, and scientific work to Horticulture.

E. O. Essig.

FRUIT GROWERS' MEETINGS IN HUMBOLDT COUNTY.

The State Commissioner of Horticulture is planning a series of meetings to discuss orchard conditions and pest control in Humboldt County. The meetings are to be held as follows:

Arcata	January 16, 1912
Eureka	January 17, 1912
Fortuna	January 18, 1912
Shively	January 20, 1912

The growers have entered into the spirit of these meetings, and a large attendance is expected.

NEWS FROM CORRESPONDENTS.

By A. J. Cook.

Daily we are receiving, in all branches of this office, queries, and information which will be interesting to the public at large. Notes from correspondence and answers to queries will receive prompt attention, and a reply in this way will make it unnecessary for us to keep constantly replying to some question which interests all.

All questions should be addressed to the State Horticultural Commissioner at the Capitol Building, Sacramento. In cases where an answer is desired at once, it will receive prompt attention by letter as well as by subsequent publication here.

The State Commissioner of Horticulture desires to identify all insect pests and injurious fungi and to advise regarding all plant diseases. Specimens of insects should be mailed in a strong box, like a pill box, that they may not be crushed in the mail. In sending, always give all possible information as to where found, extent of injury and, when possible, send specimen of plant affected. These should always be sent to A. J. Cook, office of the State Commissioner of Horticulture, Sacramento, Cal. For parasitic or precadeous insects, to be liberated in the orchard, send to the above, or to E. K. Carnes, State Insectary, Sacramento, Cal. For information regarding quarantine matters, address this office or O. E. Bremner, Room 11, Ferry Building, San Francisco, Cal., or Frederick Maskew, 703 Equitable Bank Building, Los Angeles, Cal.

SPIDERS.

Reader from Napa, California, writes:

I enclose a sample of insect found under web on some young prune trees of mine. I take it to be the red spider and would be very glad to have your opinion and advice as to treatment of parasite.—G. R. B.

The animals under the web are not red spiders, but the young of the common tree bark spider, which is perfectly harmless to plant growth.

SCALES ON LEMON.

A reader (Mrs. W. H. D.) of Los Angeles sends lemon and twig badly infested with scales and asks remedy for same.

The lemon fruit, twig, and leaf are badly infested with red scale. The large, nearly hemispherical, dark brown and black scales are the common black scale, while the flattened light and dark brown scales are commoner soft brown scale. Certainly the best remedy to recommend is fumigation with hydrocyanic acid gas, using one and one half ounces of potassium cyanide to every one hundred cubic feet of tent air space.

NOTES FROM THE COUNTY COMMISSIONERS.

By G. E. Merrill.

About two pages of each issue of this journal will be devoted to notes from the county commissioners. Commissioners who are engaged in work, news of which they think would be of importance to the general public, are earnestly requested to send brief, concise accounts of that work to the Monthly Bulletin. Manuscripts of this kind should be addressed to the editor.

The State commission was much gratified to note the almost complete attendance of the county horticultural officers at the Santa Rosa convention. It was also much pleased to note their active and intense interest in the legal and other aspects of their duties.

Throughout the State the county horticultural commisisoners are at this writing generally engaged in nursery and nursery stock inspection. In the counties of Santa Clara, Contra Costa, and Sacramento active preparations for the campaign against the pear thrips are now under way.

We are in receipt of a Weed Book from C. W. Beers, horticultural commissioner of Santa Barbara County, and the biennial report of H. H. Bowman, horticultural commissioner of Placer County. They are both printed and bound in excellent style and we commend most heartily such works, and believe that they will aid greatly in acquainting the growers of the counties with the specific local problems with which they must deal.

The State Board of Horticultural Examiners are to examine candidates for horticultural commissioners in the following counties:

Ventura County	Ventura, January 5, 1912
Kern County	Bakersfield, January 12, 1912
Nevada County	Grass Valley, January 18, 1912
Humboldt County	Eureka, January 23, 1912

COLLECTING LADYBIRDS (Coccinellidae) BY THE TON.

By E. K. CARNES, Superintendent, California State Insectary.

Throughout California the fact is quite well known that the State Insectary distributes, each year, several tons of coccinellids of the species *Hippodamia convergens,* commonly known as ladybirds, to growers of cantaloupes, prunes, apples, pears, vegetables, seeds and garden truck, for the destruction of aphid species.

Our growers know that it is only necessary to make application to the Superintendent of the Insectary, for colonies of these beneficial insects, stating the nature and acreage of the crop grown, to receive, at the proper time, a consignment of 30,000 for each ten acres, by express, charges paid, and with a free return on the shipping crates.

This new and very remarkable form of enterprise has proven a great practical success, the ladybirds being used to destroy aphids or plant lice that attack the above-mentioned crops. This line of work had its origin at the California State Insectary, together with the process of hibernating this and various other species in enormous quantities in artificial cold storage.

Experiments have been conducted along this line at the Insectary, whereby the *Hippodamia convergens* has been successfully kept in hibernation in cold storage, without impairing the vitality of the species, for seven months and fourteen days.

This particular line of work was inaugurated through practical necessity, owing to the fact that the chief obstacle to the raising of cantaloupes in California, especially in Imperial Valley, has been the attack of the melon aphis (*Aphis gossypii*), often ruining whole fields in three or four days, and no mechanical or other means of fighting them had been found effective; indeed, it was only possible to get rid of them by destroying the infested vines.

We herewith quote from various letters received, and which are on file in the office of the superintendent, from men who have grown up in the business, which not only verify the above statements, but which also testify to the results accomplished through the efforts of the insectary to aid the growers in handling one of their greatest problems:

[Copy.]

"BRAWLEY, CALIFORNIA, March 5th, 1911.

"*The State Insectary, Sacramento, Cal.*

GENTLEMEN: I can safely state, that if it were not for the many ladybirds liberated in the cantaloupe fields, the season of 1910 would have spelled failure to melon growers. As it was, the crop was saved, and the neat sum of, approximately, $350,000 was realized by its growers.

My method of control would have been a complete failure. I have always resorted to the burning of vines infested; this method keeps one man busy in an ordinary year.

Last season I burned but very few hills, being the first ones; soon the infested vines became so numerous that it would have been impossible to save them. About this time the ladybirds were arriving; after their liberation they were the busiest fellows in Imperial Valley, and it was not long till the aphid scare died out.

(Signed) ——— ——— ———."

[Copy.]

"El Centro, California, May 13th, 1911.

"*California State Insectary, Sacramento, Cal.*

Gentlemen: I desire to thank the State Commission of Horticulture for the timely supply of ladybirds furnished to our melon fields on May 7th. Forty-eight colonies were received at El Centro, and our fields of melons, comprising 1,250 acres we are growing in this locality, are being cultivated for us by Japanese, and that while these people are fully aware of the valuable work of ladybirds, they are unable to make a record of same. I, therefore, make this acknowledgment.

I have had practical experience in the growing of cantaloupes for the past seventeen years. The average acreage annually under my direction has been 5,000 acres. This year our acreage located in California, Arizona, New Mexico and Colorado approximates 5,000 acres.

During this experience it has been demonstrated to my satisfaction that no mechanical means of controlling melon aphis has yet been devised short of destroying the infested vines. The control of melon aphis in the commercial fields will be found in the work of the ladybirds.

Thanking you for your interest and valuable assistance to the cantaloupe growers of this locality, I remain,

Yours very truly,

(Signed) ——— ———,

Crop Expert for Crutchfield & Woolfolk (Pittsburg, Pa.)."

[Copy.]

"June 3d, 1911.

"*State Commissioner of Horticulture, Sacramento, Cal.*

Dear Sir: Upon my arrival at Brawley to handle about (2,000) two thousand acres of cantaloupes, I found the vines in most excellent condition, free from all aphis. Inquiring about the care that had been given to them, I was pleased to learn that the credit is given to the ladybirds. Not only this year's output over the land, but the work that was done by the ladybirds placed out last year over the same land, did their work so thoroughly that, followed up with an additional lot this year, without any question, not only kept aphids off of cantaloupe vines entirely, but it is noticeable they are in much less quantity on grain and weeds along the cantaloupe fields than previous years, and I wish on behalf of my firm, The Lyon Brothers Co., of New York, cantaloupe distributors, to commend your work.

One of the great difficulties that we have in raising cantaloupes in the different states above mentioned is the danger of aphids. In the year 1900, we had at Salisbury, Md., 100 acres of as fine a lot of cantaloupes as you ever laid your eyes on. Vines green and thrifty. We had a light shower early Friday morning, and by the following Tuesday, within three days, aphids had destroyed the whole field and made it worthless. We did not discover the aphids on the vines until they seemingly got to work, and if we had had ladybirds when we first discovered them, no doubt we could have saved the field.

We have had with us for the last four years, since we made a specialty of cantaloupes, men who have grown up in our business, and we consider them experts on cantaloupes, and all my men feel so pleased with the showing this year of the cantaloupe vines in the Imperial Valley, that they *have asked to have the privilege* of signing a paper, bespeaking praise of the work that your department of the state is doing.

We all firmly believe that if growers will place ladybirds early in their cantaloupe fields each season, they will kill off all aphids and make the growing of cantaloupes safe from that pest."

(The foregoing was signed by six field experts.)

[Copy.]

Brawley, Cal., July 14th, 1911.

"*State Insectary, Sacramento, Cal.*

Gentlemen: In appreciation of the good work you have done in the shipping in and distributing of ladybirds, and the destruction of the melon aphis, we hereby tender our thanks for the successful work accomplished in this valley.

We are at all times glad to have such successful coöperation in the destruction of aphids, and thereby aiding us in the growing of our crops."

(The foregoing was signed by twenty-seven prominent growers.)

The particular coccinellids (*Hippodamia convergens*) used in fighting aphid infestations are a species native to California. They are of a predatory habit, and their special prey and chosen food are the aphids, upon which they feed both in the larval and adult stages.

The best results are obtained by placing colonies in the infested fields or orchards at, or just before, the first appearance of the aphids; the object being to prevent the increase of these destructive insects.

Again, the female coccinellid, if the natural food is scarce in an orchard or field, is thus forced to search diligently for aphids, and will distribute her eggs in proportion to the number of aphids present; whereas, if the colonies were not placed until after the aphids had become abundant, she would deposit practically all her eggs in the same place. The same rule will apply to practically all cultivated crops, and therefore it is important that applicants for colonies of this particular species should place their order early, and again notify the Insectary when the very first aphids are noticed, and ask that their colony be sent them immediately.

It has been thoroughly demonstrated that by following such a procedure, with the help of the ladybirds, orchards and fields have been kept commercially clear of this obnoxious insect. So great is the demand for ladybirds by growers of melons and all other kinds of fruit, that the Insectary has been obliged to organize, upon a very considerable scale, the work of collecting these insects.

Many growers, residents, etc., of the State are under the impression that this enormous quantity of ladybirds is propagated at the institution in Capitol Park. Yet, if they would stop to consider for a single instant, the enormous number of aphids that the progeny from one single female will consume, they would readily understand that it would be a physical impossibility to provide sufficient food for the millions upon millions of adults that are yearly distributed from the Insectary. This will also be better understood when it is remembered that it takes 1,417 adult ladybirds to weigh one ounce; and when we are considering tons of them, the individual number is astounding.

In the course of a visit to Imperial Valley several years ago, during the first year of the horticultural and agricultural demonstration train, which was operated jointly by the State Commission of Horticulture and the University of California, the writer, personally, witnessed the great devastation being done by *Aphis gossypii* and *Aphis brassicæ* on cantaloupes and cabbages, and made the statement to the growers of that section that it was his opinion, if sufficient numbers of *Hippodamia convergens* could be collected and placed in the melon fields at the first appearance of the aphids, that the pest could be controlled through natural means, and by conserving and distributing some of our native beneficial insects.

The growers, without taking into consideration the fecundity of *Hippodamia convergens*, and without a precedent to guide their remarks, stated there were not enough ladybirds in the entire country to cover the situation. The superintendent was thus placed upon the initiative

in the matter, and, upon returning to Sacramento, completed arrangements for investigating the winter habits of this species, which had previously been noticed congregating in small colonies in the high Sierra at various seasons of the year. Taking with him two experienced field men, a systematic search was made over an extensive mountain area.

The results of such investigation practically proved the theory in mind, that this species hibernated in the adult stage in large quantities, securely hidden under pine-needles, moss and leaves deep under the snow.

Quite a number of coccinellids were brought to the Insectary from this investigation trip, and extensive experiments conducted along the

FIG. 21.—Ladybirds en route to the growers, delivered free by express company.

line of artificial hibernation, with the result that it was determined that this species could be made to hibernate artificially for several months.

Notice was sent to the various cantaloupe growers of the success of the investigation, and they were also notified that the coming spring the Insectary would, undoubtedly, be able to furnish ladybirds by the ton.

In the further interests of the growers, arrangements were made with Wells Fargo Express Company whereby the insects were to be shipped by express and delivered to the growers, free of charge, and in addition to this, a free return was granted on the empty cases. This, in brief, explains the origin of the work of conserving native beneficial insects and using them commercially to aid our growers.

The use of ladybirds for the destruction of aphids has gradually spread from their originally appointed work, until now the Insectary ships crates upon crates to practically every county in the State of California, and to growers of almost every horticultural product subject to the attack of aphid species, even including city (ornamental) street trees and home gardens.

In the past it has been argued by some persons that this being a native species, and being generally distributed over the state, that it would be useless to ship additional colonies of the same insect to those localities. The fallacy of this argument has been continually proved by practical demonstration.

Some growers go so far as to assert that the introduction of several large colonies of ladybirds into an orchard, just as the aphids are appearing, constitutes virtually a living spray.

FIG. 22.—Superintendent Carnes and Chief Field Deputy Branigan with collecting outfit and 150 pounds of ladybirds.

Again, such an argument falls flat, in the face of the ever increasing number of applications from growers begging for additional colonies, in excess of their regular allotment, and offering to pay fancy prices for them, and at the same time testifying to the excellent results received through their help.

The enormous amount of work connected with the locating, collecting and holding in hibernation, the boxing, crating, shipping and distributing of several tons of live insects is little realized by the average reader. The illustrations accompanying this article, together with the following, will give some idea of how this work is conducted:

Starting about November 1st, the field men go up into the mountains to locate the hibernating colonies, which are usually found, as already stated, among pine-needles on sunny, well drained slopes, usually in close proximity to running water.

In order to locate these hibernating colonies, it is necessary to ascend to great altitudes, which involve hard work and continual exposure to danger.

By this time the ladybirds have begun to arrive in the mountains and to assemble in colonies on the stems and about the roots of low growing plants, previous to seeking winter shelter of the pine-needles, where they are securely hidden, and inexperienced collectors may pass and repass directly over such spots and the presence of the colony will never be detected. In fact, the idea generally prevails in the minds of the mountain residents that the beetles come to the sections in the spring, and the idea is scouted that colonies of beetles spend the winter under the snow.

At this season, however, only a few of the beetles, relatively speaking, are discoverable. They are the first arrivals which have sought winter quarters early, but later on the colonies thus started rapidly grow in size. Other ladybirds join them, probably attracted by a peculiar insect odor, which they recognize, and so in the course of a few weeks immense numbers assemble.

So far, we have been content with the knowledge that enormous quantities could be procured, and that they practically return to the same place each winter, but we are now working along lines to determine why they are attracted in such numbers to these particular spots. This phase of the subject will be treated separately, probably in the next issue of the Bulletin, with the hope that it may bring forth considerable discussion on this point which will be of material use in arriving at a satisfactory solution of this phenomenon.

Just how these over-wintering colonies are located, if explained, would hardly be believed by the general reading public. In fact, it is a sort of sense that is hardly subject to analysis. Our field men know, by past experience, where the most likely places are, and how also to find the beetles. We can at least immediately tell where they are not, thus eliminating a great deal of unproductive territory from the work constituting the preliminary scouting.

Whenever a colony is located, we dig into the pine-needles, moss, leaves, etc., and through past experience we are enabled to estimate about how many pounds the said colony will yield. A little map is then roughly drawn on a card, a tree is blazed marking this spot, and the colony numbered with a notation on the back of card, giving conditions, probable amount obtainable, together with any information the collector thinks would be useful during the winter when the real work of capturing the colony is to take place. These cards are turned in at the Insectary, transferred on larger cards, and filed in our regular card index covering this particular branch of our work, thus becoming a part of the permanent record of this institution.

This preliminary scouting or reconnaissance work extends to many of the mountainous sections of northern California, or until sufficient colonies have been located, the aggregated estimate totaling the amount necessary for the coming season.

It will be understood that the work above described is but the beginning of the real work of collecting, which starts the last of December and continues until the last of February. Our field men at that time again go into the mountains and establish a camp as a center of operations, and proceed to make collections from colonies previously located. They are provided with plenty of thick clothing, heavy gloves and rubber boots, for they are necessarily exposed to severest cold, and are obliged to tramp long distances through deep snow.

When practicable a mule is taken along from the camp to carry the ladybirds, two men usually working together, and with fairly good luck they will collect from 50 to 100 pounds of the beetles in a day.

FIG. 23.—Miles from camp with a heavy load of ladybirds.

The insects are bulky, relatively to the weight, and so a mule can not very well carry more than 125 pounds of them. More often, however, the colonies are so inaccessible, and so far off from the mountain trails, that they are carried by the field men themselves into camp, slung in sacks over their shoulders. The trails in the high Sierra are usually so steep, and the footing so precarious, that riding is dangerous, and the men usually prefer to "hoof it." If a saddle mule be taken along on such an expedition it is allowed to go first, and the field men have the animals pull them up the steep grades, by hanging on to their tails.

Various methods of separating the ladybirds from the pine-needles and débris have been tried out and discarded. The most successful

arrangement, and the one now in use, has been a canvass sack, open at both ends, with a coarse mesh sieve sewed in one end of the sack, composed entirely of wire, the bottom of the sack being tied with a draw-string and securely fastened. The use of this is quickly seen when the men get to work, for the beetles are found in clustered masses, often as big as one's two fists, under the leaves and pine-needles on the ground. Two men usually work together; one man scoops them up and throws them into the sieve, while the other man passes them through, rejecting as much of the vegetable and other débris as he can possibly get rid of.

When the sieve-sack is full they are transferred to ordinary flour sacks, securely fastened at the end, and laid out on the snow, later to be taken out via the mule pack train to the railroad.

Inasmuch as the colonies in December and January are usually buried

FIG. 24.—Showing combination sieve and sack used by collectors.

beneath several feet of snow, it would not be possible to find them but for the maps previously made on the cards in the manner already described. Provided with these maps, our field men know just where to look and lose no time. Their task, however, is difficult and laborious, often exceedingly risky; they are obliged to travel over trackless wastes among the mountain peaks, fording streams of icy water, crossing swollen creeks on impromptu bridges, made by felling a tree, and in many cases, in fact entirely too often for the general comfort of the collectors, they suddenly find themselves taking an ice-cold bath, with the snow-clad peaks for an audience. Being several miles from camp, the pleasure of continuing a day's work with drenched clothing, or tramping back through the snow to the camp for a change, constitutes but one of the many incidents that occur in connection with this particular branch of our work, caused by being impeded in their movements by huge sacks of beetles that must be brought back to the camp somehow.

Usually once a week a mule pack train comes over the mountain trail to the camp to bring supplies and to carry away the sacks of beetles which have been accumulated. By this means the insects are conveyed to the nearest railway station, which is a distance of about twelve miles, where a small building has been rented and equipped as a packing-house. Here the crop is cleaned, put up in suitable packages, and made ready for the long hibernation.

At times it is necessary for the collector, on the preliminary trip, to do actual collecting. This is necessary when colonies are found in localities that are absolutely inaccessible later on in the season. In such cases the colonies are collected and transported and artificially colonized in places where they can be easily reached when wanted.

FIG. 25.—Waiting for the mule pack train to carry ladybirds to railroad.

Between the time that the field men return from the preliminary location and the time the real collecting begins, the Insectary force, assisted by the field men, are busily engaged in making the shipping crates. Each one is 13 inches long, 8 inches wide, and 12 inches deep, covered on two sides with fine mesh wire netting and loosely filled with dry, clean excelsior. These receptacles are eventually to contain the ladybird crop, and when completed they are shipped to the packing-house in the mountains.

During the packing season one man is left in charge of the packing-house, who attends to recleaning and resacking the insects. He then proceeds with the next step in the packing process, which is to pour the

bugs from the sacks into an ingenious machine which counts them: they are counted, that is to say, by measurement. Dropping into a sort of hopper, made of tin and glass, they are measured as they pass through this machine (which is operated by a system of slides) into the shipping crates before mentioned.

The beetles are now in their final packages ready for distribution. But the time when they are needed will not arrive for six months, and meanwhile they must be kept alive and in first class condition. This, indeed, is the most difficult part of the whole business, the great problem being, as will be understood, to extend by artificial means, the natural

FIG. 26.—Interior view of mountain packing house showing measuring and packing machine.

hibernating period of the beetles in such a way that they may not lose any of their vitality.

In order that this may be accomplished they must be kept cold, without exposure to any marked change in temperature. If they are allowed to become warm, even for a little while, or moisture comes in contact with them, they will heat and cake into a solid mass, thus killing the entire colony in a remarkably short time.

To avoid the heavy expense of artificial cold storage we keep them at the mountain packing-house as long as possible, when they are transferred to a large cold storage room rented from a commercial company in Sacramento, and a temperature slightly under 40 degrees Fahr. maintained. This serves the purpose excellently, but plenty of ventilation

is an absolute necessity, and the air must also be slightly moist, and the "crop" requires continual attention and at times the conditions must be changed quickly, or the entire lot will be lost.

The insects are packed in colonies on an average of 33,000 to each colony. They are distributed in various ways; the small individual colonies being sent direct to the applicants, while large consignments intended to cover an entire district, such as the Imperial Valley, are usually preceded by an agent from the Insectary, who figures out the acreage and prorates the amount that can be supplied to each grower or association, and personally attends to the distributing of the colonies.

Last season's crop was exceptionally large, and when massed at the State Insectary, just prior to the actual shipping season, this lot of insect friends, combined with all the other various species of beneficial insects propagated at the Insectary, constituted what was undoubtedly the largest number of beneficial insects ever assembled at one place in the history of the world.

The foregoing is but one phase of the work, following the effort being made by the California State Insectary, to render direct aid to the individual grower, and to assist him to raise larger crops of cleaner fruit at less cost.

ROOT-KNOT.

By E. J. Newcomer.

The disease properly known as root-knot, and sometimes called beaded root-knot or root-gall, is caused by a minute Nematode worm, known as the eelworm (*Heterodera radicicola*). This worm has been found in about 480 different kinds of plants, and occurs in nearly every civilized country of the world. In the United States it is largely confined to the southern states, and east of the Mississippi River it has done great damage to various crops.

Root-knot occurs in California on a number of plants, notably figs, grapes, peaches, tomatoes, beets, and various nursery stock. Although it is not at all rare, it has never been of very serious importance in this state.

Root-knot appears on the roots of most of the plants affected, as swellings or knots of varying size, but usually small, rarely exceeding an inch in diameter. The average diameter of those on some fig roots examined was from an eighth to a quarter of an inch. Most of those larger than this were really composed of several knots, but these grew so close together as to appear at first sight as a single swelling. These knots sometimes occur in such numbers along the root as to give them a beaded appearance.

The true root-knot should not be confused with crown-gall, sometimes wrongly called root-gall or root-knot. As Professor Cook explained in the January number of this Bulletin (p. 64), crown-gall is a bacterial disease, while root-knot is caused by an animal. Crown-gall occurs usually about the crown or on the larger roots, while root-knot affects

the smaller roots as a rule. The former gall is a roughened, irregular swelling, an inch or more in diameter, and its presence often causes the plant to send out a large number of small roots at the point of infection. The swelling caused by the eelworm is smaller and usually less than half an inch in diameter, and no extra roots grow as a result of it. The swellings of root-knot are much more numerous on the roots than those of crown-gall. The surest, though perhaps not the easiest way to tell the difference, is to cut or break open some of the galls. If they are the galls of root-knot, they will contain a number of small cavities, in each of which is a pearly-white round body or, if this has been broken, merely some liquid. This body is the adult eelworm, as explained later. The galls of crown-gall contain no such bodies, being caused by organisms much too small to be seen by the naked eye.

Recently the eelworm has appeared in potatoes grown in several of the western counties of Nevada, and there is danger of its becoming established in the potato fields of California, if, indeed, it is not already to be found here. The disease has not been serious in any plants in this State, but as it affects directly the edible part of the potato plant, and injures its appearance and value, it would seem that in this case it might become serious. The galls necessarily have a different appearance on potatoes than on ordinary roots, owing to the difference in the size and structure of the part affected. Affected potatoes are roughened and warty, the small individual galls being distributed irregularly over the surface.

DESCRIPTION OF WORM AND LIFE HISTORY.

If a bady affected potato is cut across, a number of small brown spots will be seen, about a quarter of an inch from the skin of the potato. There may be only a few of these spots, or they may be so numerous that they form a ring around the cut surface. The brown spots are really hardened, diseased areas, and if one of them is carefully opened it will be found to contain a small, glistening, nearly round body, less than one twenty-fifth of an inch across, which looks like a minute pearl. These bodies will often be seen when the potato is cut open if the knife just misses them. If it touches them, however, they burst and are not noticeable. In hard roots, such as those of figs or peaches, they are more difficult to find, as they are very easily crushed or broken when the hard gall is cut open.

This small pearly body is the adult female eelworm. It does not look at all like a worm; it is the males and the young that have the eel-like form. The adult female is really a pear-shaped body (Fig. 27, 5 and 6), and it lives in the brown gall, with the head, which is the part corresponding to the stem end of the pear, sticking out into the tissue of the potato. The head (Fig. 27, 7) is provided with a boring apparatus, which at this stage is used only for feeding, as the adult worm is not capable of moving about. This consists simply of a sharply pointed spear (*s*), which is in the mouth. Leading from the mouth is a tube, the gullet or œsophagus. Father back, this is thickened into a muscular bulb (*o*), which is probably used in sucking in the food.

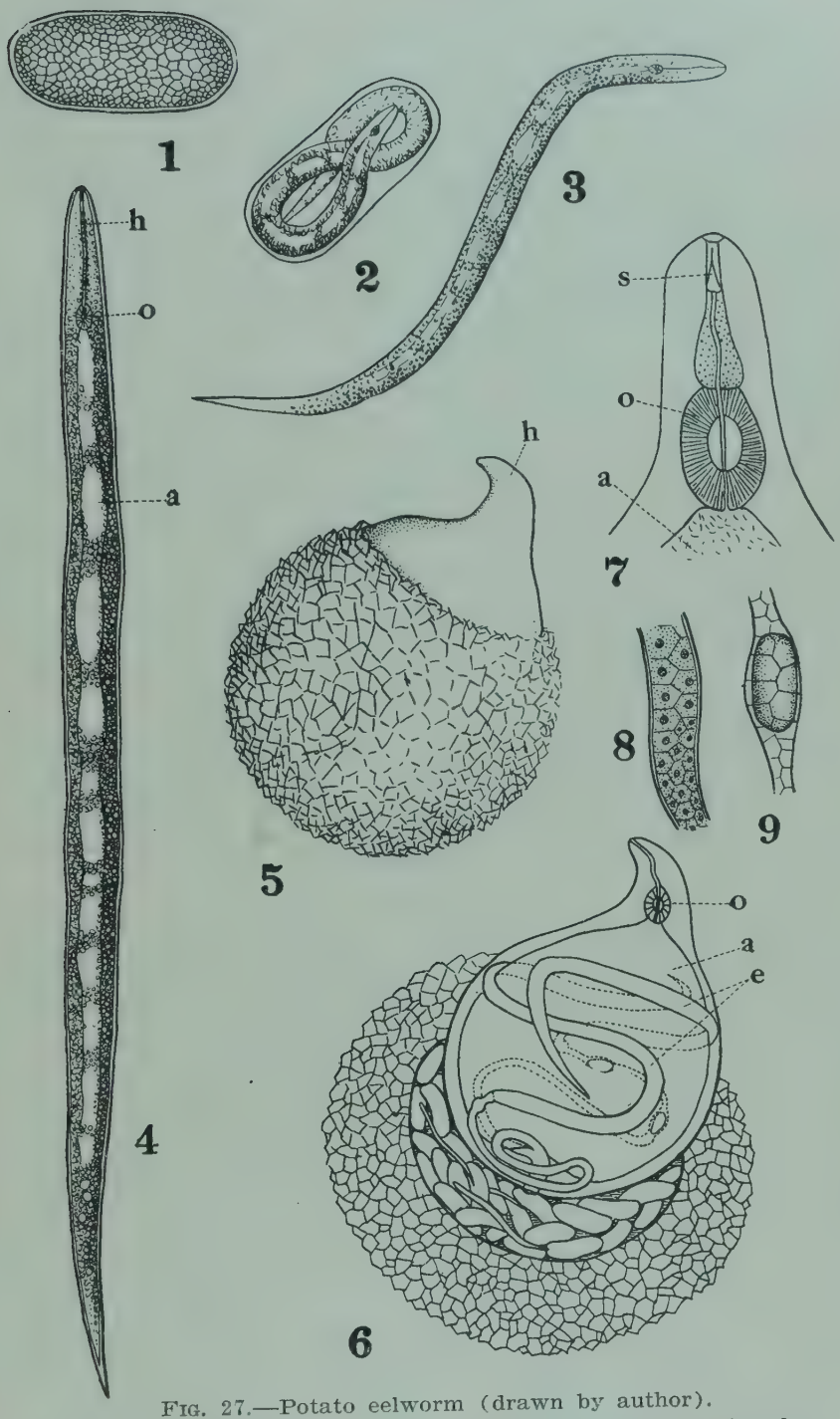

FIG. 27.—Potato eelworm (drawn by author).

1, egg, magnified 200 times; 2, egg, showing developing larva within; 3, young larva, magnified 200 times; 4, same, magnified 350 times; 5, adult female and gall, magnified 70 times; 6, same, opened, showing organs of female, and eggs and young larvæ as they are found in the gall; 7, head of female, greatly enlarged; 8, part of egg tube, showing forming eggs; 9, another part of tube, with a fully formed egg in it. *a*, alimentary canal; *b*, egg tubes; *c*, head; *o*, œsophagus; *s*, spear.

The rest of the alimentary canal, which is nothing more than a big sac, is just behind this bulb and fills up most of the body.

The egg-laying apparatus consists of two long egg-tubes (*e*) coiled around the alimentary canal. These tubes join and open to the exterior at a point about opposite the head. The eggs are formed in the ends of the tubes (Fig. 27, 8 and 9) and pass through them to the outside. They lie packed together in the gall, and when this is opened the eggs and young larvæ can be seen in a mass (Fig. 27, 6).

The eggs are quite small, and can not be seen without using a lens. They are whitish, partially transparent, and bean-shaped (Fig. 27, 1). The young worms, or larvæ, develop within the egg, and just before they hatch they can be seen, with a microscope, coiled up inside (Fig. 27, 2). After hatching, the larvæ are straight or nearly so, long and worm-like, with a blunt head and a tapering, sharply-pointed tail (Fig. 27, 3 and 4). They are so small and transparent that they can scarcely be seen with the naked eye. The larvæ have the same digestive system as the adults, except that the alimentary canal is long instead of sac-like. The boring apparatus is the same as in the adult, and is used both for feeding and for boring through the plant tissues. The egg-tubes are not noticeable.

The larvæ may bore into other parts of the root that they are already in, or they may go into the soil, where they are able to live, apparently without food, for several months. These latter, when opportunity offers, bore into the roots of some other plant, become adult, and repeat the life-cycle.

CONTROL.

Dr. E. A. Bessey, of the U. S. Bureau of Plant Industry, has recently published an excellent bulletin (Root-Knot and Its Control, Bul. 217, Bureau of Plant Industry, U. S. Department of Agriculture, 1911), on the subject of root-knot, from which I have taken several points in regard to the food-plants, distribution, and life-history of the eelworm. Dr. Bessey has thoroughly studied the matter of controlling this worm, and it seems advisable to give here in condensed form some of the methods described by him, for the benefit of those to whom his bulletin is not accessible.

To begin with, it is undoubtedly a better policy to prevent the entrance of a pest into a region than to allow it to enter and have to fight it afterwards. In districts where the eelworm does not exist, only perfectly sound potatoes from uninfested districts should be used for seed. Nursery stock is largely responsible for the spread of the worm, and a great deal of this spread can be prevented by careful inspection.

In localities where the eelworm is already found, there are a number of control measures which may be employed. In greenhouses the best method recommended is the use of live steam. This, of course, can only be used for sterilizing the soil before plants are put into it. Pipes are laid at the bottom of the beds, about a foot apart, and perforated every few inches with small holes. Steam is forced through the pipes

at good pressure and escapes through the small holes, killing all worms and other life in the soil. If the beds are covered with sacks or boards, an hour or two will be sufficient to completely sterilize the soil. Perhaps it would be simpler in most cases to put fresh soil in the beds every year, this soil to be obtained from non-infested places. The old soil should be allowed to dry out for several weeks before being removed, to kill most of the worms, and after its removal the framework or benches should be whitewashed or disinfected with a solution of formaldehyde. One part of 40 per cent formaldehyde to 100 parts of water is strong enough. This same solution will practically sterilize the soil in the beds, if used at the rate of a gallon or more to every square yard of surface. This solution has been used for soil containing plants, but, as many plants are injured by it, it must be used with great care. By these methods and the careful inspection of stock, the worm should not be troublesome in nurseries.

In California, outside of nurseries, the disease of root-knot has not proved serious. This may be partially explained by the fact that the worm can not live very long in dry soil. The dry summer months here are propably sufficient to kill most, if not all, of the worms. As a matter of fact, however, the disease is most common in irrigated regions. On account of this susceptibility to dryness, it should be an easy matter to free a tomato or potato field, for instance, of worms, by plowing, and allowing it to dry out thoroughly during the summer, and at the same time freeing the field of all roots and weeds, as these may give food to the worms. Other methods are flooding for three or four weeks, or keeping the land free of all vegetation for two years, but neither of these would be practicable in many cases. Trap crops have proved of little value. Sometimes a rotation of crops is advisable. Certain crops, such as iron cow-peas, velvet beans, rye, and winter oats are but little attacked by the worms, and if these are planted for two or three years, and all weeds that the worms might feed on kept out, the worms will be starved. Injury by the worms is often greatly reduced by the use of fertilizers containing potash.

Where perennial crops are grown, such as figs, grapes, and other fruits, the selection of resistant stocks is undoubtedly the best means of avoiding root-knot. Many of the phylloxera-resistant grapes are but little injured by the eelworm. Some figs are less susceptible than others. A number of varieties of other plants are known to be resistant, but more experimenting is necessary.

A NEW INSECT PEST (*Trioza alacris* Flor.).

By D. L. Crawford, Stanford University.

A new pest has made its appearance in this State from Europe. It is a gall-making species of the family *Psyllidæ*, *Trioza alacris* Flor., which has been known for over twenty-five years to attack and seriously disfigure the leaves of certain ornamental shade trees all over Europe.

This insect has been brought into our State on nursery stock, and probably has by this time established itself, though perhaps not extensively yet. Specimens in all stages, together with the disfigured leaves, were found by Mr. O. E. Bremner, state quarantine deputy, on the ornamental laurel, *Laurus nobilis*, in the nursery yards of Domoto Brothers in Oakland. These affected trees are said to have been imported from Belgium several years ago. The pest has been found also in San Mateo County on laurels. No further reports of its existence have as yet come to me, but in all probability it will be found in other localities throughout the State.

The principal hosts in Europe thus far known belong to the laurel genus, *Laurus*. Other related trees have been attacked to a less extent. Inasmuch as the laurel is being used here more and more as an ornamental shade tree, the danger from this insect is very real.

The insect is related to the scale insects, plant lice, and white flies (*Aleyrodidæ*), and like all these gets its food by sucking the juices from the leaves of the tree. It is the irritation produced by the sucking of the numerous little bugs that causes the leaves to roll on the margins, become swollen or else blistered and greatly distorted. In addition to the injury to the tree through the loss of so much sap is the injury by the distortion of the leaves, making the tree very unsightly. The work of these insects is very easily detected and can scarcely be mistaken for anything else, unless it is the elm-leaf roller, an aphid. In order that any one may recognize the insect, a description of it in its various stages is given here.

The eggs are minute and whitish, elliptical in shape and are attached to the leaves by a slender hair. They are so small as to pass unnoticed, except when a careful search is made for them with a magnifying glass. The season of egg laying varies with the locality and the climate, but in this part of the State would probably be in the spring and again in the fall.

The larvæ are grayish white in color and become darker as they approach maturity. When full grown they are about an eighth of an inch long, almost round and very flat, laying closely flattened against the leaves, usually in the hollows produced by the rolling or the folding of the leaf. On examination with a good hand lens, they will be found to be bordered with a fringe of hairs around the margin. The antennæ are short, about four- or five-jointed, varying with the age of the individual. The legs are scarcely visible except by looking at the ventral side of the insect, and are short. The eyes are darker than the rest of

the body and very conspicuous. The beak or sucking tube is very long and slender.

As the larva reaches maturity, the wings begin to appear first as so-called "wing pads." The principal difference between the larva and the pupa is in these wing pads, which are constantly growing with the adult wings developing inside of them.

The adult or perfect insect has four transparent wings folded roof-like over the body. It is about three sixteenths of an inch long, rather slender, and looks more or less like a plant louse (aphid) at first sight. It may be easily distinguished, however, from the latter by the fact that it jumps actively while the aphids do not. The wing venation is more complicated, also, and the antennæ are usually ten-segmented, while the eyes are very much larger than in the plant lice.

All stages of the insect may be found at the same time and on the same tree. The larvæ move about very slowly when distributed, or when looking for a new place to insert the beak for sucking. They are most often found in the folds of the leaves and usually are covered with a white, cottony mass which they excrete from the body.

The best means of control for this pest is a kerosene emulsion or crude carbolic spray applied at least twice with an interval of about two weeks between the applications. Unless the spray is applied carefully enough to insure its entrance into the rolled leaves, the insects will not be killed. It is because of this protection which they make for themselves that they are so difficult to control.

While the insect is still limited in its distribution, measures should be taken at once to eradicate it entirely from the country. There is no telling when it may change its food habits, if there are not enough laurels to feed on, and attack some of our other shade trees or our fruit trees. The great harm done by the pear tree *Psylla,* a near relative of this psyllid, ought to be sufficient warning to arouse every one against it. It has been established in this State, and now *must* be wiped out while this is still possible!

Special attention must be directed to this pest by all horticultural inspectors and especially by the quarantine men. With proper inspection of foreign nursery stock, this could not have entered as it did. It is safe to say that by the present method of strict inspection at San Francisco, by the state quarantine inspectors, such a pest as this could not pass undetected on nursery stock. It is the duty of every inspector, not only in California, but in every other state as well, to make a similar thorough examination of all nursery stock. We have more insect pests *now* than we wish. Let us not bring any more from abroad to add to the list.

QUARANTINE ORDER No. 8.

WHEREAS, Quarantine Order No. 3, Tulare County, California, only permitted fruit to be delivered at Porterville, Lindsay, Exeter, Tulare, Visalia, Ducor, Dinuba, Cutler, Pixley, Angiola, and Terra Bella, as other railroad stations of the county were without agents; and

WHEREAS, Strathmore, Sultana, Tipton, Goshen, and Farmersville now have agents at each of these places; therefore, it is

Declared, That all the stations named above be places for delivery of nursery stock, fruit trees, fruit and plants, and which if found free from insects or disease will be released by the Deputy Quarantine Officer of said county.

A. J. COOK,
State Commissioner of Horticulture.

Approved:
(Signed) HIRAM W. JOHNSON,
Governor of the State of California.
Sacramento, California, January 25, 1912.

QUARANTINE ORDER No. 9.

WHEREAS, There exists in several of the states of Mexico a very serious insect pest, namely, the Mexican or Morelos orange fly, *Anastrepha (Trypeta) ludens* Loew.; and

WHEREAS, This fly attacks oranges, guavas, and mangoes and is exceedingly destructive to all such fruits; and

WHEREAS, Said orange fly is free from parasites and very difficult to combat; and

WHEREAS, Steamships from Mexican ports and railroad cars traversing these infested areas come direct to our State and may, and very likely will, be the bearers of affected oranges, guavas, or mangoes, and so may bring this orange maggot, *Anastrepha (Trypeta) ludens*, into the State of California, which if introduced, would bring incalculable loss to our people; therefore, be it

Directed, ordered and declared, That a quarantine be and the same is hereby established in accordance with the law approved by Governor Johnson, January 2, 1912, against the importation of citrus fruits, guavas, or mangoes from the states of Mexico, either by boat or rail, and that, as heretofore, all cars bringing oranges, guavas, or mangoes from Mexico into the United States must be thoroughly fumigated before they enter the State of California.

A. J. COOK,
State Commissioner of Horticulture.

Approved:
(Signed) HIRAM W. JOHNSON,
Governor of State of California.
Sacramento, January 25, 1912.

QUARANTINE ORDER No. 10.

WHEREAS, There exists in the nurseries of Santa Clara, Alameda, Santa Cruz, and San Mateo counties a serious insect pest, known as the California or Western peach tree borer, *Sannincidea pacifica* Riley; and

WHEREAS, Several affected trees have been shipped from said nurseries into other counties of California within the past few days; and

WHEREAS, Said insect is a serious enemy of all stone-fruit trees, as the borers girdle or seriously wound the crown of infested peach, plum, apricot, prune, nectarine, cherry, and almond trees; and

WHEREAS, This caterpillar or borer is not known to be a pest in other countries and its introduction would be a serious injury, and must be resisted; and

WHEREAS, The borer when young and small will elude the keenest inspection; therefore, it is hereby

Ordered, directed and declared, That a quarantine be and the same is hereby established in accordance with section 2319*b* of the Political Code of the State of California, against the shipment of peach, plum, apricot, prune, nectarine, cherry, and almond trees from any of the aforesaid counties.

A. J. COOK,
State Commissioner of Horticulture.

Approved:
A. J. WALLACE,
Acting Governor of State of California.
Sacramento, January 29, 1912.

THE EUROPEAN ELM SCALE.*

(*Gossyparia spuria*, Modeer.)

By Samuel B. Doten, B.S., Entomologist, Agricultural Experiment Station of the University of Nevada.

Life history.

As the methods of destroying the European elm scale are founded on its life history, the following account of the different stages through which it passes will be of interest.

On an infested elm during the winter it is easy to find rows and clusters of dead female scales from the preceding summer (Fig. 28, 1).

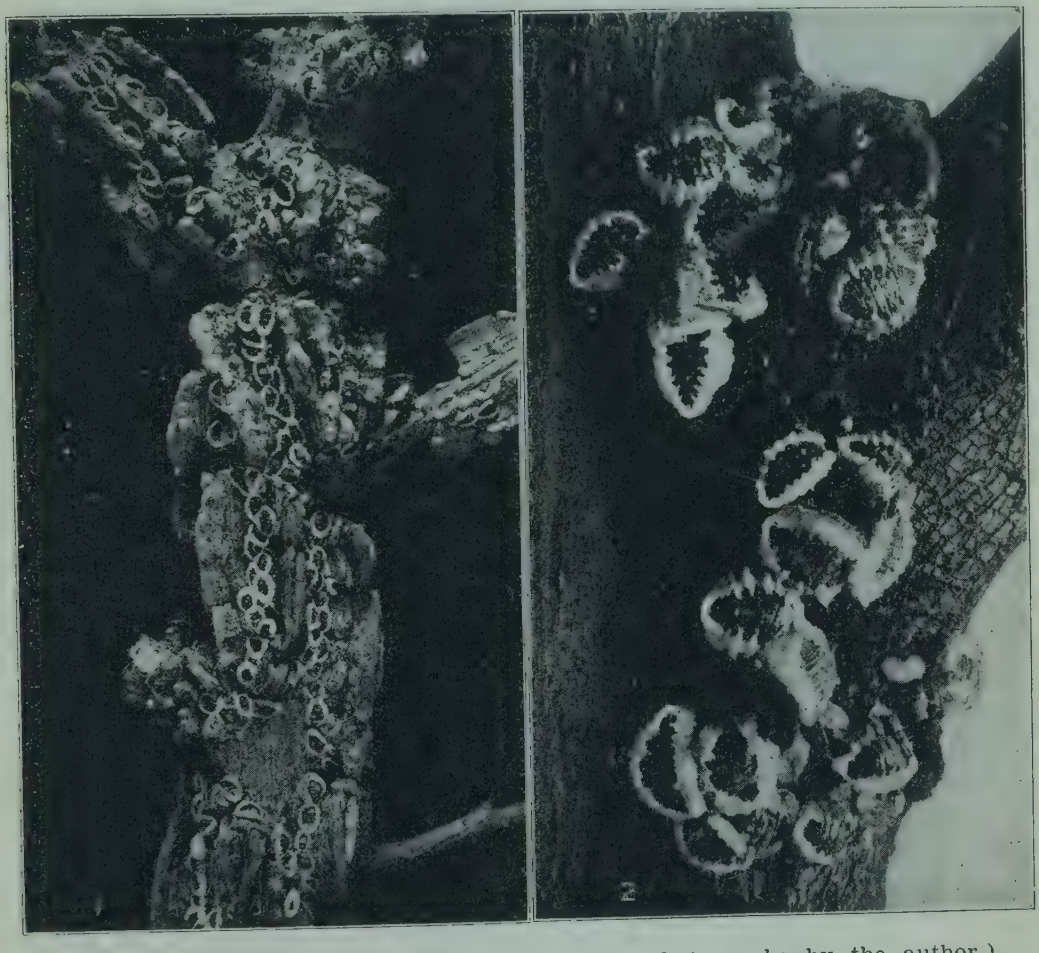

Fig. 28.—European elm scale, female. (From photographs by the author.) 1. Dead females in winter on cork elm. Natural size. 2. Living females in summer (x 4).

They are small, dark brown insects, about one eighth of an inch long, dried and shrunken; each is surrounded by a conspicuous oval ring of dusty gray, waxen material.

Only the half-grown scales are alive through the winter (Figs. 29 and 30). They are in a dormant condition and usually occupy protected

*We are greatly indebted to Professor Doten for this article and especially for the free use of his excellent cuts which were originally published in Bull. No. 65, February, 1908, of the Agricultural Experiment Station and Agricultural College at Reno, Nevada.—*Editor.*

situations. Some occur in clusters on the smooth bark or about the bases of twigs. Some are crowded in and around the waxen rings of the dead females; very many crowd into the deepest cracks of the bark. On cork elms they lie in long rows between the ridges of cork on the twigs and limbs. These wintering larvæ (Figs. 29 and 30) are about one eighteenth of an inch long; in color, grey like the bark. The magnifying glass shows that the purple brown bodies of the young scales are covered with gray, waxen bristles, which give them a most peculiar hedgehog appearance. With the coming of the first warm days of spring many larvæ leave their winter hiding places to wander about on the limbs seeking permanent resting places for the summer season, while others remain in the cracks and crevices of the bark (Fig. 34).

The male larvæ are much inclined to gather in clusters about the base of some projecting twig or on a smooth spot of the bark, and to excrete their cocoons there side by side (Fig. 32). As a result, it is common in the early spring to see here and there on the bark, in spots and patches, hundreds of male cocoons, pure white, like clusters of tiny rice grains. Each cocoon is about one eighth of an inch long, and is open at the rear end for the escape of the mature insect. It consists of felted fibers of wax excreted by the male larva and matted together to form the cocoon. The males leave their cocoons in April and May. The first which appear bear imperfect wings; those which emerge later are active, two-winged flies, about one sixteenth of an inch long; the bodies are purple-brown in color, the wings pearly white; the body bears two long, white caudal bristles (Fig. 33). The males die after mating with the females.

The females (Figs. 35 and 36) after mating settle for the summer in certain habitual situations, which fact is important for the owner of the elms to recognize. They select the under sides of horizontal branches. Though many will be found on the bark of vertical limbs and occasional specimens may be found on the trunk, especially about pruning scars, yet by far the commonest situation is the under side of the lower branches.

The young begin to appear late in June, and each female continues to produce young throughout the summer, none of which will be mature until the summer following (Fig. 31). In bright sunlight the newly hatched young appear as tiny yellow specks, crawling over the bark and leaves or in struggling masses beneath the females. They settle on the leaves, usually on the under side along the midrib, and remain there throughout the summer, usually abandoning the leaves in late summer and autumn and settling for the winter on the bark of twigs and limbs (Fig. 31, 1).

Extent and character of injuries.

Usually the effect of the European elm scale does not become very noticeable until after the tree has been infested for two or three seasons. Then in midsummer the leaves are small and stunted, dull green or yellowish instead of dark and glossy. The general appearance of the

FIG. 29.—Hibernating larvæ. (From photographs by the author.)
1. On elm bud (x 16). 2. Surrounding dead females (x 8). 3. In crack of elm bark (x 8). 4. About base of twig (x 8).

tree is sickly and weak, small branches die here and there in full leaf. Occasionally, the infestation is so severe that the whole elm dies; but, as a general thing, the tree is simply stunted and made unsightly by

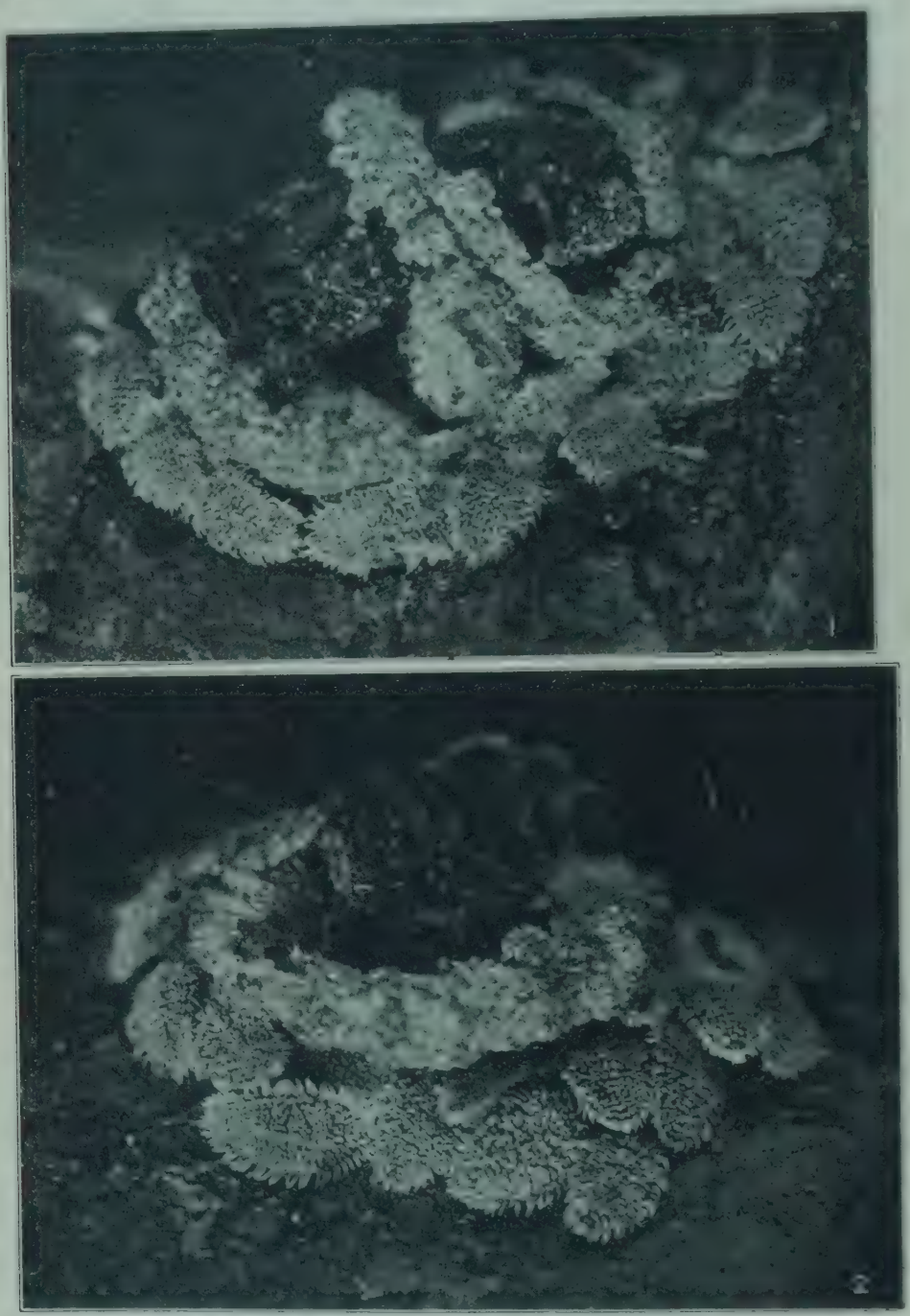

FIG. 30.—Hibernating larvæ. (From photographs by the author.)
1 and 2. Larvæ in winter; around and in, and beneath the semi-cocoons of dead female (x 16).

the presence of the insects. One of the most characteristic things in the appearance of the infested elms is the premature yellowing of leaves on the lower branches. Late in the summer, long before autumn

colors should appear, the lower leaves turn yellow or red-brown and begin to fall prematurely, while the tree takes on a most characteristic sickly appearance, so much so that it is an easy matter to pick out infested elms at a considerable distance. It is often easy to discover infested trees in midwinter by the fact that here and there low down

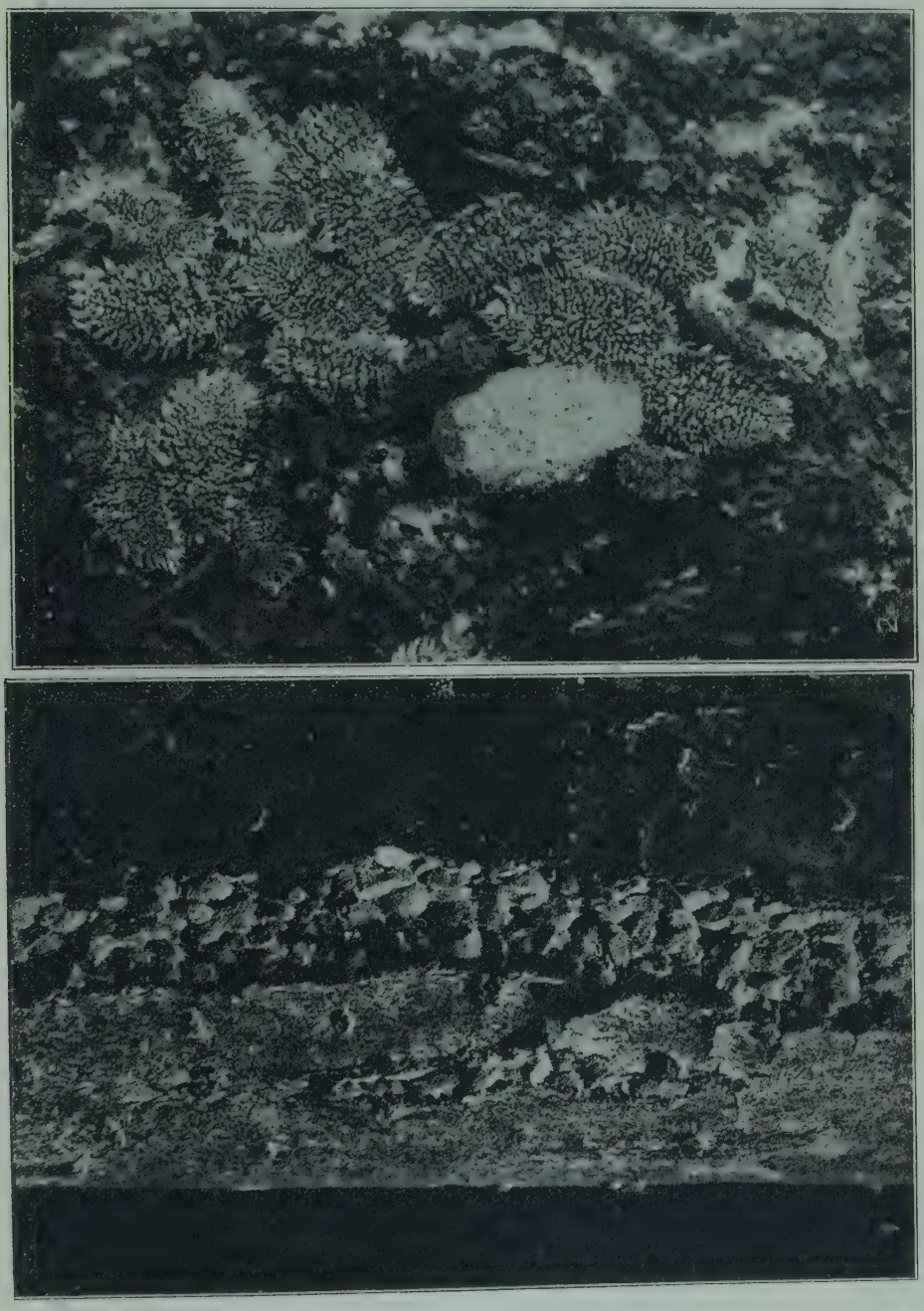

FIG. 31.—Larvæ in early spring. (From photographs by the author.)
1. Crack in elm bark full of hibernating larvæ (x 4). 2. Larvæ and male cocoon (x 16).

on the tree there are twigs with dead leaves hanging; for when twigs die suddenly in midsummer the leaves do not fall but remain on the tree through the following winter. Trees bearing such twigs with dry,

brown leaves hanging in the winter are very often infested with the European elm scale.

All species of elms are infested, but the American elm or white elm seems to suffer most severely. In general, young elms are more severely injured than are the older trees. The English or cork elm is very

FIG. 32.—Cocoons of the male. (From photographs by the author.)
1. Larvæ excreting cocoon (x 16). 2. Cocoon finished. Anal filaments of male protruding (x 16). 3. Cocoons (x 4).

generally infested, but many of the older trees seem to reach a sort of compromise with the scale, a balanced relation where each elm bears a certain amount of scale, but where the increase is not so marked as to threaten death or even serious injury to the tree.

Remedies.

Pruning, thinning and washing.—There are certain conditions of growth which are especially favorable to this insect. It thrives best and is most injurious on young and crowded trees. Elms are usually planted much too close together. As long as they are small this makes little

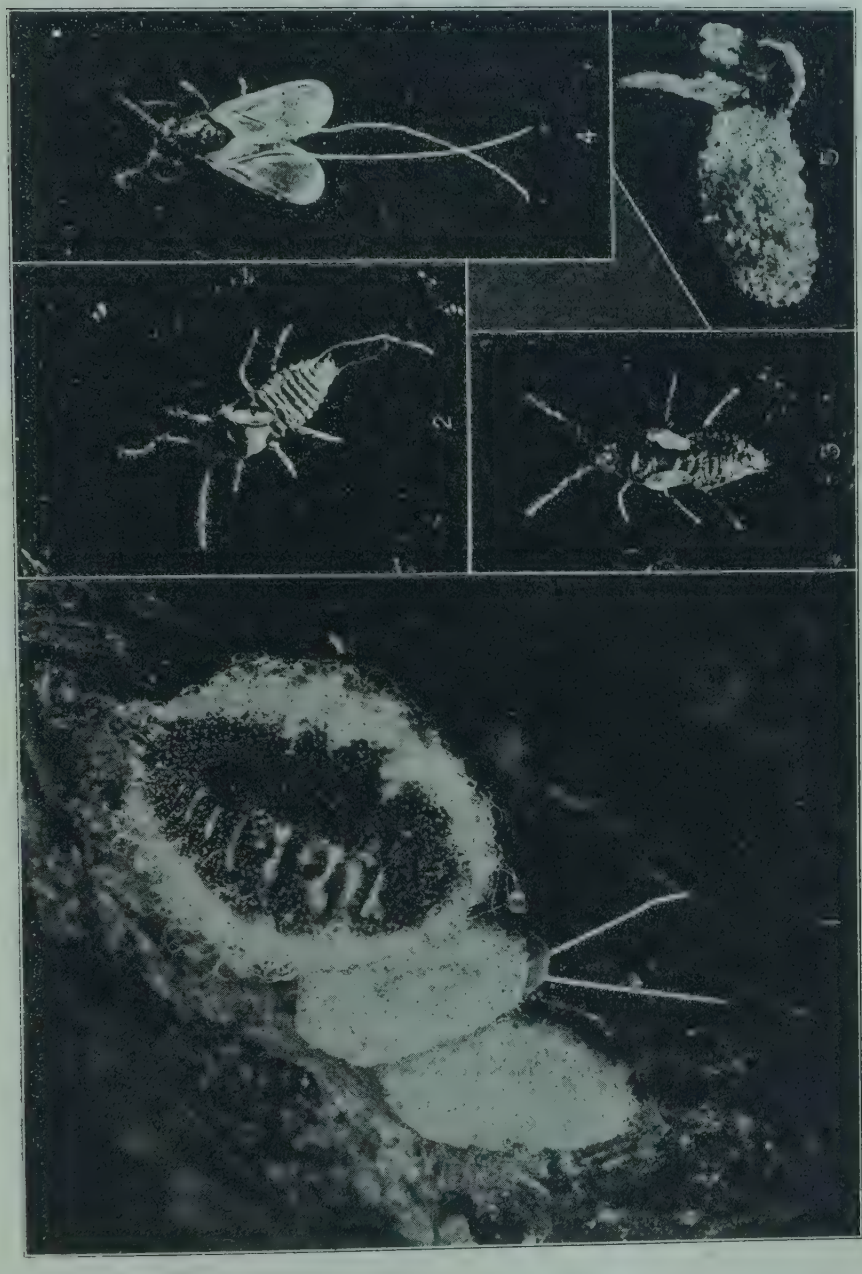

Fig 33.—*Gossyparia spuria*, male (x 16). (From photographs by the author.)
1. Cocoon with protruding wings and anal filaments. 2 and 3. Wingless males. 4. Winged male.
5. Cocoon, cast skins of larva and pupæ.

or no difference; but when they grow larger and the branches begin to interlock there is an intense competition among them for air and sunlight. Each limb shades and crowds the others. Elms forty feet high may well be fifty feet apart; yet it is no uncommon thing to see half a dozen English elms crowding the life out of one another in front of a single fifty-foot lot. Under such conditions the spread of insects from tree to tree is very rapid. Insect injuries are severe, while any

form of spraying is exceedingly difficult, almost impossible, in such a tangle of rough and corky branches.

Now, one way out of this is to prune the elms in question back nearly to stumps, cutting every branch off near the trunk. This is a common and stupid practice. Truly, most of the scale is on the limbs; there is very little on the trunk. If you cut off the limbs you certainly get rid of most of the scale, but a far better method is to prune closer still—just below the surface of the ground, in fact. An elm should be encouraged to grow into a tall, broad, spreading tree, with a high, solid trunk. It should be headed high. People forget that a useful shade tree should grow high and broad enough to shade the roof of the house at noonday. Crowded elms will not do this. They stunt one another. A single tall, spreading elm is worth a dozen twiggy, scaly, little scrubs. Where elms are crowded, half of them should be cut down and made up into stove wood.

Crowded trees infested with the European elm scale should be thinned out by cutting down half or more of them. The remainder should be pruned judiciously into an open, spreading form which plans for the future and which will admit air, light, and the spray-nozzle to all parts of the head.

Method of washing elm trees infested with European elm tree scale.

For several reasons we have found it advisable to abandon the practice of spraying infested elms with the various oil emulsions, scalecide, etc., which we formerly employed. It is not that we have found good grounds for objection to these preparations, either in a lack of killing properties or in any injury to the trees, but simply that we have found the method of washing simpler, cheaper, and on the whole quite as effective.

It is only the force of the stream which makes washing effective. Here the water pressure runs from 60 to 70 pounds to the square inch, and it is amply sufficient to throw a strong stream from a small nozzle attached to an ordinary garden hose. The stream thrown violently against the bark dislodges the scale insects which are unable to return to the tree. They are very readily dislodged from the smooth-barked elms, but from the cork elms, *Ulmus campestris*, they are dislodged with greater difficulty. In general, however, the scale is found on the lowest limbs and grows most abundantly on the under surface of the limb. For this reason it is readily accessible and is removed without great difficulty.

We find, after some three years' experimental work, that it is not particularly advisable to wash the trees in midwinter, for at that season the larval scale insects are often hidden in cracks in the bark where they are protected from the force of the stream. Late in the spring, about the time when the first leaves appear, the female scale insects become very conspicuous as they excrete white, waxen rings and become engorged. At this time the force of the stream is very effective, readily washing away the engorged females and destroying them. A little delay, however, is dangerous at this time; for, as soon as the females become engorged, they begin to lay eggs and the larvæ scatter out upon

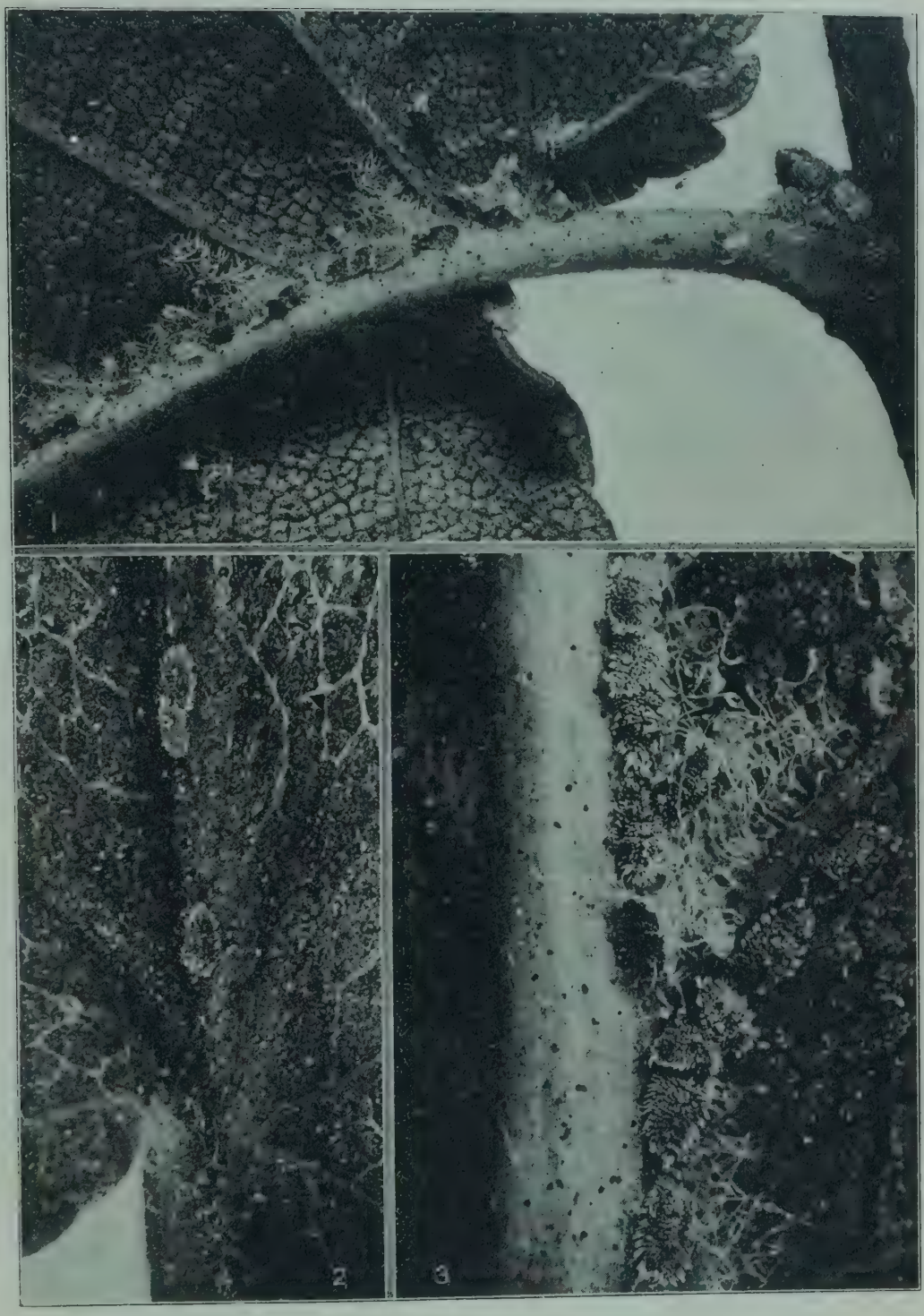

FIG. 34.—The larvæ in summer. (From photographs by the author.) 1 (x 8) and 3 (x 16). Along mid-rib on under surface of leaf. 2 (x 16). Recently hatched larvæ on the upper surface of leaf.

the leaves, where they are almost invisible and are protected or concealed by the leaf-hairs. For this reason it is important that the washing shall not be deferred long after the females begin to excrete their white, waxen rings and engorge themselves.

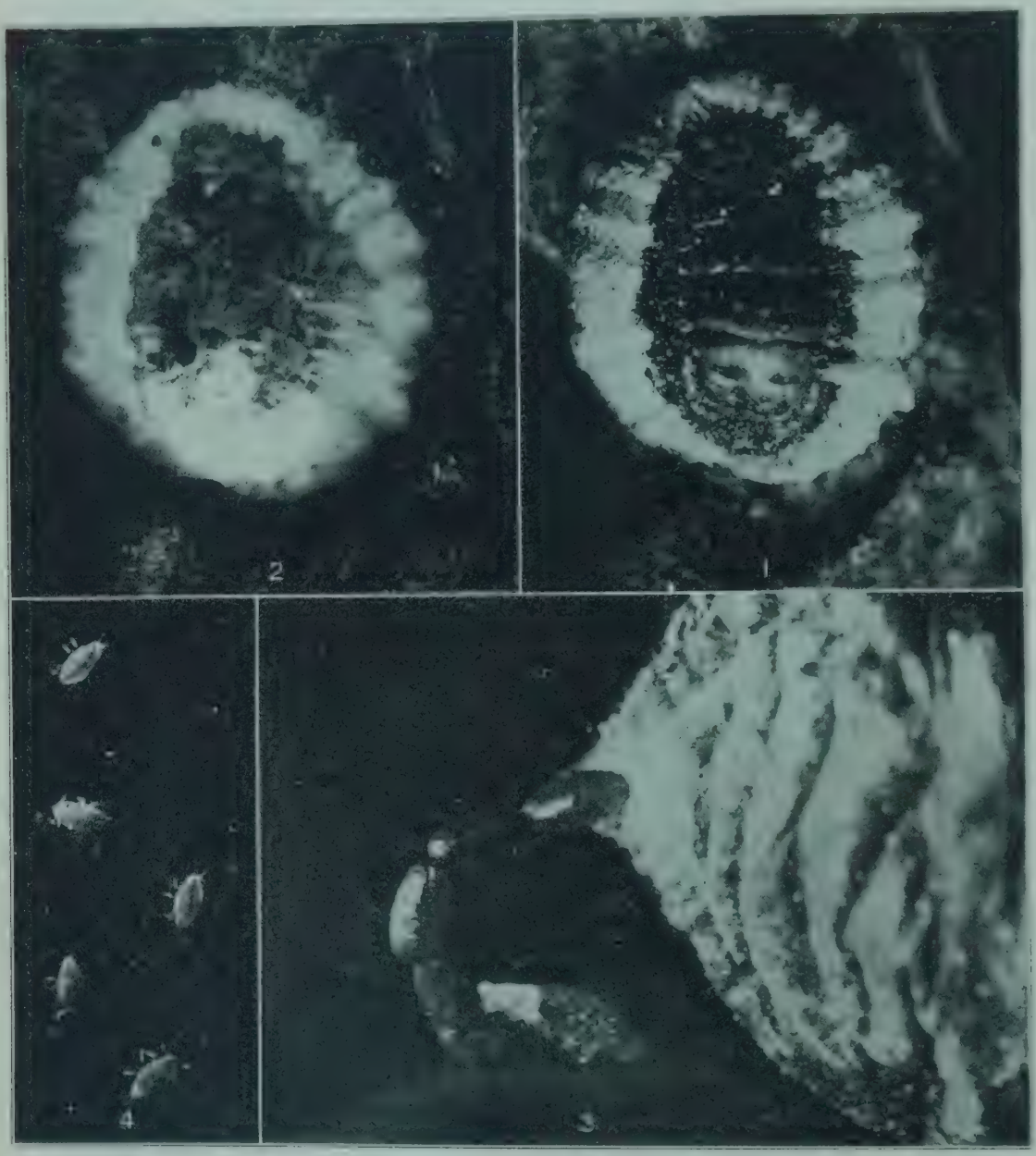

FIG. 35.—Eggs and larvæ. (From photographs by the author.)
1 and 2. Egg-shells and struggling larvæ beneath female (x 16). 3 and 4. Eggs and hatching larvæ (x 40). 4. Larvæ (x 16).

The apparatus (Fig. 37) which we have been using in washing trees is simple. It consists merely of some six feet of ¾-inch galvanized iron pipe, with pipe-to-hose connection at one end and such a nozzle as will throw a hard, strong stream at the other. A six or seven foot length of pipe is about as long as a man can handle readily. Usually a man

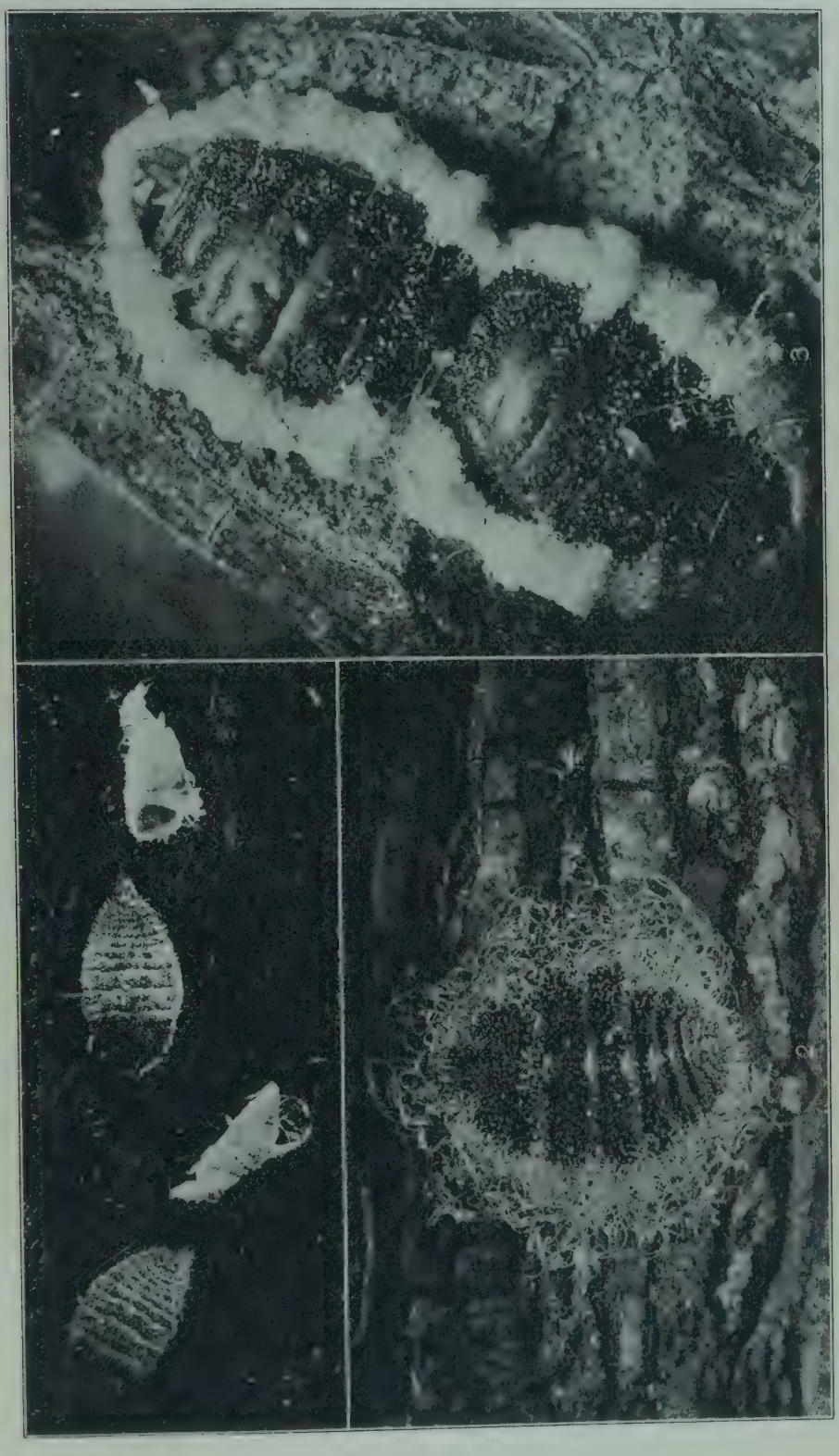

FIG. 36—*Gossyparia spuria*, female (x 16). (From photographs by the author.)
1. Just before impregnation. 2. Excreting semi-cocoon. 3. Fully mature, engorged with eggs.

wears a broadbrim felt and a waterproof coat, with boots or rubbers, for naturally this process of washing is rather a wet job, although it is much less messy and obnoxious than spraying either with lime-sulphur or oil emulsions.

In two or three favorable locations, as in one of our city parks and on the high school grounds, we have found it advisable to employ a larger hose and a much stronger stream, although usually with an extension pipe. This strong stream tends to rip all the cork from the cork elms, and it certainly cleans and appears very effective when the washing is done at the right time and thoroughly.

Of course, everything depends upon the systematic thoroughness of the washing. J. A. Longyear, the county horticultural commissioner of Washoe County, Nevada, has succeeded repeatedly in freeing trees from the elm scale in a single year, or rather washing out so many that the remaining ones do no further harm for the year. His system is as follows:

1. He trims the infested tree into an open and spreading form, making every portion of it readily accessible to the stream, taking out all dead wood and very many of the smaller twigs.

2. He then washes the trees from all four sides, branch by branch, following each branch down from the smallest twigs to the trunk, aiming to have the force of the stream search out every crevice of every bit of bark from twig to trunk.

3. In a few days he returns, glances over the trees and washes away any scales which are then visible.

In this manner he so reduces the number of egg-laying female scales that those remaining do little or no harm. It is of course necessary to give the elms one such washing every year, but this, with the necessary pruning, is of very decided benefit to the tree. Occasionally, where trees are very heavily infested, we have found it advisable to wash the trees quite thoroughly early in the spring to free them from the dead female scale of the previous year, and as far as possible from their larvæ, following this by a second washing quite late in the spring when the females of the new generation are about to lay their eggs.

FIG. 37.—Spray nozzle and rod used by Professor Doten for washing infested elm trees.

1, nozzle; 2 and 3, extension pipe, six or seven feet long and seven eighths of an inch in diameter, fitted with a hose connection at the end.

On the whole, it appears from our three years' experience that where trees are washed thoroughly with a strong stream, the scale is readily held in check. The trees remain healthy and grow vigorously. Two things only are necessary; that the stream be strong and thoroughly applied, and that the washing should be done at the right time of the year.

EUROPEAN ELM SCALE IN CALIFORNIA.

By C. W. Woodworth.

The presence of the European elm scale in California has been known for some years, but few are aware of the fact that it is getting to be rather widespread. In the second annual report of the State Commissioner of Horticulture, Mr. Carnes writes: "In one locality in California it gained quite a foothold, but prompt remedial measures were applied, and the scale has not been allowed to increase, although scattering specimens may be found on some of the trees originally infested."

The insect occurs in great abundance in Stockton, Colusa, Palo Alto, Santa Clara, and San Jose and perhaps in other points.

(*Mr. E. K. Carnes, superintendent of the State Insectary, also reports this scale as a pest on elm trees in Ukiah.*—Editor.)

THE CODLING MOTH.

By A. L. Melander, Entomologist, Washington State College, Pullman, Washington.

The control of the codling moth is determined by several fundamental principles, which may be outlined as follows:

1. Most codling worms seek to enter the apple through the calyx end. Some normally enter through the side, but the majority find the calyx end. This applies to both early and late worms.

2. Newly hatched worms are careful of their first feedings. If their nibblings are distasteful, they are not swallowed, but are rejected.

3. Those worms that find the calyx end are apt to swallow their first feedings, for the calyx is not lined with a tough skin. If the calyx is filled with poison these worms are killed.

4. Many of the worms that enter through the side of the apple reject the nibbled skin, and do not swallow their feedings until they reach the pulp. Even if the outside of the fruit is repeatedly sprayed, apples will become wormy or at least "stung."

5. Obviously, then, it is good policy to poison the calyx, which can be done only by a special method of spraying, and during the few days following blossoming. The spraying must be completed before the calyx lobes close up.

6. It is impossible to fill the inside calyx cup without coating the outside of the fruit and the leaves as well. This poison will materially help in destroying the first brood, and the fewer first-brood worms that escape, the cleaner will be the crop at harvest. If some worms manage to enter the fruit, their progeny will find the unsprayed apples or the unthinned clusters, and the orchard loses in wormy fruit many times the cost of the extra care required to effect a complete extermination of the first brood.

7. To force the spray into the bottom of the calyx requires a high pressure, a coarse nozzle, and the spray must be driven straight at each flower. Two hundred and fifty pounds makes an ideal working pressure.

The Bordeaux nozzle (such as the Bean clipper) gives the best results, and the spraying can be most easily and surely done if the nozzle is attached by a "crook" elbow coupling, and the spraying is done from a "tower" or elevated platform. Most of the spray must be shot downward, but some must be thrown in every other direction. The higher the pressure, the more sweeping the spray and the less attention need be given individual apple clusters.

8. A "single spraying" implies that *every* blossom be filled to the bottom with spray. Tear apart a few blossoms picked here and there and see if the spraying is thorough. If the trees blossom irregularly, repeat the spraying for late blossoms. An application given then is worth more than if applied at any other time of the season.

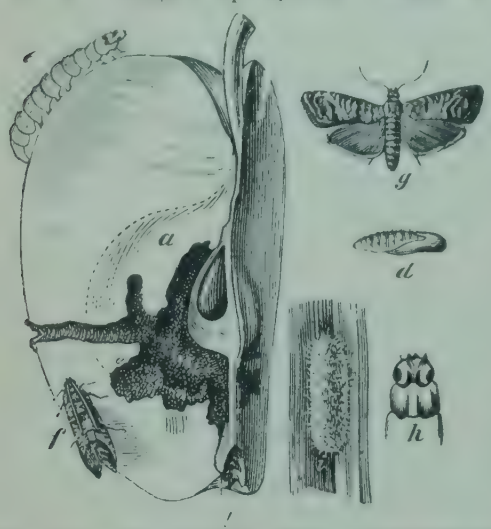

FIG. 38.—The codling moth, *Carpocapsa pomonella*. *a*, apple cut to show borings of the larva; *b*, place where the egg was laid and the larva started; *d*, pupa; *e*, larva; *f*, *g*, moths at rest and with wings spread; *h*, head of larva; *i*, cocoon. (U. S. Dept. Agrcl.)

9. The spray poison used should be flocculent and tasteless, such as arsenate of lead. It must not be used too strong, nor should it be mixed with lime, sulphur-lime, or Bordeaux spray, or the young worms may refuse to swallow it. One pound of paste arsenate of lead will answer for fifty gallons of spray.

10. The calyx spraying alone has sufficed to control the codling moth under the conditions found in thousands of acres of commercial orchards in the Northwest. Additional sprayings may be given, and often must be given, but usually they prove unsatisfactory. A second application two to six weeks after the first, a third given a month after the first worms are trapped under the bands, a fourth and a fifth following at intervals of a month complete the program formerly in vogue. If the calyx spraying is imperfectly given, of course, it can not be expected to assure 100 per cent returns, but to-day many growers are able to do this spraying so thoroughly as to depend on it alone. Whether one or many sprayings be considered necessary, it is certain that the method that poisons the *inner* calyx cup will prove the most satisfactory single treatment that can be given.

GENERAL NOTES.

WHY COUNTY INSPECTORS SHOULD INSPECT CONSIGNMENTS WHICH COME INTO THEIR DISTRICTS AFTER BEING RELEASED BY THE STATE INSPECTOR.

By B. B. WHITNEY, Quarantine Inspector, San Francisco.

Section 1 of the quarantine laws provides for the eradication and destruction of all infested or infected articles, packages, or soils, etc., with such species of injurious insects, eggs, larvæ, pupæ, or other animal or plant disease which may be, or be liable to be, injurious to orchards, vineyards, gardens or farms within California. Such infestations shall be destroyed or reshipped out of the State. There is always a possibility of some insects escaping detection, and again there is always a chance of some escaping destruction in the disinfection. If some or even one female insect escapes, there is very grave danger of introducing this pest into previously uninfested localities.

County inspectors examine all horticultural products passing into their counties from neighboring counties in order to prevent the introduction of pests not already in their districts. It seems as though it should be fully as important to inspect that coming from other states and foreign countries.

The majority of shipments coming to San Francisco are consigned to custom-house brokers, and, after being released by the inspector, are usually distributed throughout the State, and are generally passed by the county inspectors without further examination.

Shipments may be consigned to San Francisco and afterwards be shipped to Los Angeles, and as every one knows there are insects in northern California that do not exist in southern California and vice versa, we inspect each tree, shrub, vine, fruit, etc., individually, and I would suggest that county inspectors do the same with all foreign shipments, regardless of the treatment they have received from the state officers.

ARIZONA CIRCULAR NO. 16.

Dr. Morrill has issued a very helpful circular specially useful for horticultural inspectors. The county commissioners and inspectors are often sorely perplexed as to the wisest and fairest course, and the judgment and advice of one so able as we know Dr. Morrill to be will be prized.

Dr. Morrill insists that a certificate of inspection and freedom from pests, from place of shipment, will not suffice in Arizona. One such small shipment had over 2,000 aphids not in Arizona. Another large shipment of peach trees, certified to as above, showed every tree attacked by Eastern peach borer.

The laws of Arizona are strikingly like our own, though do not contain the clause of our new law, permitting the destruction of plants which can not be retained safely, whereas the Arizona law, like our old law, permits *owner* to destroy or ship from the State at his option.

In a mixed shipment, if it is safe to do so, only the affected variety is destroyed. Thus, if a shipment of apples and peach trees was received, the peach attacked by borer, which never attacks apple, the apple would not be condemned. If a shipment of trees from the same nursery, and shipped all at the same time, contains any affected trees, all are to be condemned.

Defoliation of all deciduous trees, cape jessamine, privets, and Chinese umbrella trees must be insisted on. The above named stock, including citrus trees from Texas, North Carolina, Georgia, all Gulf states, Yuba and Butte counties in California, is quarantined against as possible carriers of white fly (*Aleyrodes citri*).

Arizona, for convenience, is divided into districts which somewhat correspond to our counties. The inspection must be impartial, but not too arbitrary. For instance, stock will not necessarily be condemned if received in a district already infested. I should say, "Why not?" I would not wish to set trees bearing black scale, purple scale, red scale, or mealy bug, even if my neighbor had these pests in his orchard. But Arizona is wise, I think, in refusing to release trees if any are affected, and also refusing to permit treatment to remove the ban.

It is sanely and emphatically urged that all shippers of nursery stock into Arizona use the utmost care and send only clean stock, or else they will lose all, or otherwise have a large freight bill to pay, as such trees will not be released or received, though Dr. Morrill will admit San Jose scale into some districts, for while it has been there for years it seems to do no harm. I wonder if this is wise? For years the black scale did no harm in portions of southern California; later it became a great pest. Insects do change their habits.

The circular concludes by commenting on the following insects to be barred out: Black, purple, red and yellow scales, mealy bugs, white fly, thrips, aphids, destructive moths and butterflies, and such beetles as leaf-beetles, borers and weevils.

OUR COURSE.

I hope our county commissioners will procure and carefully study this circular. Many of the points urged are practical here.

I would urge that we insist that all stock be clean. If a shipment of peach trees is found with even a few trees attacked by borer, the entire shipment should be refused, and the nursery from which they come should be from thence on a suspect. A certificate from place of shipment should not free trees from close inspection in any part of California, nor should we regard with favor the receiving of affected trees, even though treated. It is difficult to kill every insect or to know that it is done.

Again, if we refuse unclean stock, we shall soon receive only that which is clean. The nurseries will see to it that all their trees are free from pests. Mr. Bremner tells me that since they have destroyed infested trees from Japan so absolutely, much less infestation is found in the shipments from that country.

A. J. Cook.

NOTES ON THE NURSERY INSPECTION.

One of the most obvious conditions of the California nursery business at present is its prosperity. This condition is due to two factors: First, the good price obtained for fruit last year; second, the increased plantings in anticipation of the Panama-Pacific Exposition. The influence of the exposition is especially noticeable in the call for ornamentals. Many nurserymen report that they are unable to supply the demand in this line. There is also a scarcity of nearly all deciduous stock.

The writer has been agreeably surprised to note the comparative freedom of most nurseries from insect pests and plant diseases. To date only a few lots of infested stock have been found that had eluded the vigilance of the county inspectors. In each of these cases the infestation was one of comparatively minor importance on ornamental trees. Almost uniformly the quarantine guardians report that the incoming stock this year is notably clean. This condition may undoubtedly be ascribed to a wise enforcement of the quarantine laws, and to the fact that knowledge is abroad that none but clean stock is welcome in California. To be sure some badly infested and diseased lots have been found and condemned. Probably the most trouble has come from the wooly aphis on apples, the peach-root borer, the flat-headed borer, and root-knot caused by nematodes on various deciduous trees. Instances of crown gall are not rare on some of the home grown stock.

Although the majority of California nurseries are clean, the prospective buyer of nursery stock should investigate the character of the concern with which he is dealing, and the history of the stock he buys, more fully than is usually the case. He should deal either with a nurseryman of whose integrity he is sure, through personal experience, or with one whose reputation for honesty and square dealing is well established. Such nursery men are not necessarily the largest dealers in any particular locality. However, the honesty of the nurseryman is but one consideration. The buyer should also satisfy himself as to the character of the stock—what root was used in propagating, the character of the bud wood, and the general health and vigor, size, etc., of the trees purchased. Stock grown on land that has produced the same kind of stock for a series of years should be avoided.

The advice to beware of the nursery stock grower who is only in business from year to year is sometimes given. Yet the bulk of the stock grown by such men is usually bought up by the larger nurseries, and resold by them to customers who are kept in ignorance of the origin of the stock they are buying. The large dealers in nursery stock in the majority of these cases have probably satisfied themselves of the quality of the stock bought up. Frequently, though, their facilities for doing this are no better than those of the grower to whom they sell the stock. Under these conditions, the chances that the buyer has to obtain first class stock are no better than those he would have if he went out and purchased it himself direct of the grower.

The old adage, "Let the buyer beware," is one that is particularly applicable in the purchase of nursery stock.

G. E. Merrill.

A MODEL BULLETIN.

Bulletin No. 223, by H. J. Quayle of the College of Agriculture, University of California, is certainly a "record breaker." We have rarely, if ever, read a practico-scientific bulletin with keener relish.

The subject, "Black Scale," is most timely. There is no single insect that draws so heavily from the pocketbooks of our fruit growers as does the black scale (*Saissetia oleæ* Bern.). Moreover, it lives and works throughout the whole State, claiming tribute from the citrus orchards of the south and from the deciduous orchards from the Mexican line away to the north.

This bulletin is to be commended for its completeness, as it covers the ground thoroughly, and is just what the intelligent man needs. It will prove invaluable to the orchardist.

It is unnecessary to call attention to the subjects treated, as it covers the whole ground. This is an example which all practical scientists who essay to instruct men actually at work in the field may well follow.

Mr. Quayle still minimizes the damage from the *Saissetia*, except that which comes from the injurious effects of the smut fungus (*Meliola camelliæ* Catt.), which is always attracted by the abundant honey dew which is secreted by this scale. As I have before stated, I believe the sapping of the plants is quite as serious a hindrance to their vigor as is the black fungus. Much smaller scale insects that produce no honey dew do very serious damage, so why not this giant by comparison, when, as is often the case, it fairly crowds its mates on the orange, the olive or the apricot? This, of course, is a matter of opinion, and no criticism of this admirable brochure.

Among the plants attacked, I see no mention of our most beautiful conifer *Cedrus deodara*. I have seen this tree fairly black with this scale. Mr. Quayle gives 2,894 as the maximum number of eggs laid by a single female. I have had my students at Pomona College year after year count the number of eggs, and 3,312 were once counted, the product of one female.

Mr. Quayle's demonstrations regarding rate and distance of travel are most interesting, and his experiments to show means and rapidity of distribution are very suggestive.

I studied the tulip or linden scale (*Eulecanium tulipiferoa* Cook) in Michigan some years ago, and found that I could force or anticipate the breaking of anchorage by simply picking the affected leaves. The quiet scales would loosen their grip and commence to travel. I concluded that the drying of the leaves created an unrest that led to weighing anchor.

I learned for the first time in reading this bulletin that our brown apricot scale, heretofore known as *Eulecanium armeniacum* Craw., is correctly known as *Lecanium corni* Bouché.

The frosted scale (*Lecanium pruinosum* Coq.) is referred to as working on the European walnut, and while I found this the favorite food

plant in the south, I found it also working on the orange—once—and on apricot trees.

The various predaceous and parasitic insects attacking the black scale are well described, and the illustrations throughout are most helpful and excellent. No one interested can afford to be without this valuable treatise, and we only hope for more like it.

A. J. Cook.

STATE QUARANTINE IN SOUTHERN CALIFORNIA.

The quarantine division of the State Commission of Horticulture operating in Los Angeles County, and represented by C. H. Vary and the writer, intercepted, examined and passed upon 3,040 packages of horticultural products entering Los Angeles County from outside the State during the month of December, 1911. Of these, 2,312 arrived by water and 728 by rail. The possibilities of undesirable immigrants accompanying these shipments are significantly emphasized by the following enumeration of their widely spread points of origin: Turkey, Japan, Holland, Mexico, France, England, and many of our own states in different parts of the Union.

Of this total of 3,040 packages, it was found necessary to fumigate the contents of 510 and to completely destroy the contents of 12. The reason for these drastic measures in the matter of the twelve packages was the finding of plants and trees from Japan infested with the *Aulacapis pentagona* and other forms of *Diaspinæ,* and of species of white flies on the plants from Mexico. The fruit confiscated and destroyed during the month consisted of typical Mexican varieties well known to be host fruits of several species of fruit flies of the family *Trypetidæ.*

The quarantine inspector, Avery S. Hoyt, in charge of this work at the port of San Diego, has sent in a report which shows a busy month in the district under his immediate charge. Thirty-two steamers entered that port during the month of December, and the horticultural products landed from each one were all inspected and reported upon in proper order. Six of these vessels came directly from a territory well known to be the habitat of several species of fruit flies, and eighteen from a locality that is contiguous to the same. The persistent proselytism among the officers and crews of these regular liners by the horticultural quarantine officers is resulting in new converts every voyage, whose words and actions in regard to contraband fruit are greatly influencing the amount and variety of the same found in the possession of the passengers and also in the ships' stores of these vessels arriving from foreign ports.

The policy of State Commissioner A. J. Cook in placing an additional inspector on the force of the southern division, was for the purpose of enabling the state quarantine deputy to periodically visit the local quarantine guardians at points south of Tehachapi, study the methods in vogue, and, if possible, draw still tighter the quarantine

measures inagurated for the protection of the crop producers of California. The volume of imports arriving since this addition was made to the force has precluded any attempt at such proposed extension work so far; in fact, had it not been for the courtesy of County Horticultural Commissioner A. R. Meserve, who placed at the disposal of the state officers the clerical and telephonic facilities of the county office, the imports of Los Angeles County alone would have been more than the present force could have handled with the required dispatch. This rush, however, has enabled us to systematize the work, and we hope to be able in the very near future to carry out in detail the plans of the state quarantine officer.

FREDERICK MASKEW.

HORTICULTURAL MEETINGS IN HUMBOLDT COUNTY.

The recent meetings held in Humboldt County by the State Commission were a decided success in many ways. The attendance was good, there being 90 present at Arcata, 50 at Eureka, 95 at Fortuna, and 75 at Shively. Those present were all fruit growers vitally interested in the topics discussed, and much data were derived from experienced orchardists of the various communities. The discussions of pest control were taken up with vigor, and in every locality preparations were immediately begun to secure proper spraying apparatus and applications. At Shively, where the green apple aphis has done much damage, the growers made up an order for twenty barrels of commercial lime-sulphur spray to begin work at once on the eggs of the above mentioned pest while the trees were still dormant.

The matter of selecting suitable varieties of apples for Humboldt County was thoroughly discussed, with the result that all future plantings will be made along lines of selecting those varieties which are now doing best in that county; as, for instance, the Rhode Island Greening, Red Pearmain, Bellflower, Spitzenberg, and King of Tompkins County.

Perhaps no other topic received so much consideration as the appointment of a single county horticultural commissioner. The great interest taken is revealed by the fact that eleven applicants appeared to be examined for that position. And that is not all; the growers have taken steps to send a strong delegation to meet the supervisors in behalf of the newly appointed commissioner, to demonstrate that they are vitally interested in the office and intend to give it their hearty support and coöperation.

E. O. ESSIG.

NOTES FROM THE COUNTY COMMISSIONERS.

By G. E. Merrill.

As far as possible the quarantine guardians of the State should supply themselves with Bulletin 186, Bureau of Plant Industry, Field Studies of the Crown Gall and Hairy Root of the Apple Tree. In this bulletin is a complete account of the diseases on apple trees, which matter is, of course, applicable to the crown gall in other plants.

A close perusal of the bulletin will aid in clearing up many doubtful point in the minds of some of our commissioners.

San Joaquin County.—Mr. Garden, the County Horticultural Commissioner, reports extensive planting of peaches in his county this season. The favorite varieties are Alberta, Lovell, Tuscan Cling, and Phillips Cling. Prunes are also being extensively planted.

Tulare County.—Mr. Schulz, County Horticultural Commissioner, is prosecuting a campaign against the mistletoe, as a bad host of *Aspidiotus hederæ,* commonly known as the ivy or oleander scale. A large acreage of citrus fruit is to be planted this year in Tulare County.

Fresno County.—Mr. Schell, County Horticultural Commissioner, and inspectors are busily engaged in the inspection of outgoing and incoming nursery stock. A large acreage of deciduous and citrus fruits and vines is being planted in Fresno County this year.

Alameda County.—County Horticultural Commissioner Mr. Seulberger reports that through his efforts the Southern Pacific and Western Pacific railroads have removed the bull thistles and other noxious weeds from their right of ways, throughout his county.

Yolo County.—A well attended fruit growers' meeting was held at Winters under the auspices of Mr. Geo. H. Hecke, County Horticultural Commissioner. The object of the meeting, which was addressed by Mr. Jeffrey, was to pave the way for the unit organization of the Deciduous Fruit Protective League. The pear thrips was also discussed.

Examinations.—Much interest was manifested in the county commissionership examinations recently held in Ventura, Kern, Nevada and Humboldt counties. Four candidates were examined in each of the counties of Ventura and Kern, six in Nevada, and eleven in Humboldt. Of the total number examined, twenty-five, eight passed.

BORING INSECTS.

By A. J. Cook.

Strange it is, how insects in their evolution, have sacrificed to gain safety. The several borers that are often so frightfully destructive are ready to feed continuously on sawdust pudding that they may hide in their wooden tunnels. Their slow development as larvæ proves their diet lacking in substance.

There are five orders of insects that furnish these miners: The *Hymenoptera* give us boring bees (*Xylocopa*) and wasps (*Pemphredonidæ*), ants (*Componotus*), these last two are really innocuous, and the horn-tails (*Sericidæ*). A species of this last family works in the canes of raspberries, etc., in the foothill counties, and will soon be discussed in this Monthly Bulletin.

Strange as it may seem, we find some of our most destructive borers among the *Lepidoptera*. Yet all caterpillars are mandibulate or biting insects, and their strong jaws fit them to act as gnawers, par excellence. The wasp-like moths, *Sesiidæ*, are all borers and exceedingly destructive. The larger and more robust *Cossidæ* are always formidable though fortunately not numerous.

The *Coleopterous* order gives us three families of very pernicious borers; the *Buprestidæ*, or big-headed borers, the *Cerambycidæ*, or round-headed borers—the longicorns, and the *Scolytidæ*, or bark beetles. Some other species of weevils are also borers.

The white ants, order *Isoptera*, family *Termitidæ*, are among the most extensive borers and not infrequently do no little mischief here in California, though it is in the tropics that they work their greatest havoc.

The California Peach Borer. (*Sanninoidea opalescens* Hy. Edw.) (Figure 39.)

This insect, which is a Western species, peculiar to California, Nevada, and Oregon, is a serious pest of all stone fruits; peach, apricot, plum, prune, almond, nectarine, and cherry. It is thought to work less damage on any of these when they are grafted on myrobalan stock, an imported wild plum. Like the Eastern peach borers, it is more serious if trees are injured or in poor thrift, and when grown on sandy soil.

Except for coloration, this insect is very similar to the Eastern peach borer (*S. exitiosa*). Practically the two insects may be regarded as identical. Both are beautiful wasp-like moths, but the female of the California species has the anterior wings wholly opaque, and the female of the Eastern species instead of having the body wholly black or blue-black has a conspicuous orange band crossing it.

Life History.

The moths of this Western species come forth from May till October, and mate at once, when they commence to lay their eggs. These latter are very minute, brown in color and are placed usually on the trunk of the tree near the earth. They are deposited in groups from one to a score or more. The eggs hatch in about two weeks, when the minute

whitish caterpillars, each with sixteen legs and a few scattering hairs, seek at once a convenient crevice or place of concealment.

It begins at once to feed, eating into the cambium layer, and surrounds itself with its excreta, the gum of the tree, and the chips which it forms. It may be found in varying sizes, from a mere speck to an inch in length, almost any time from November to May. Mr. Moulton, in his admirable bulletin, says it may be found a half inch long almost any month of the year. Only last week, February 10th, I found larvæ, hardly large enough to see and others in the same tree more than half an inch long. When the larvæ become full grown they form a cocoon of chips, frass, and silk, much the form of a cartridge, line it with silk and soon pupate. I found in studying the Eastern borer that the longevity of the larvæ varied greatly. I think this depends upon the character of the tree as to the health, the heat, and, I dare say, the soil and soil moisture. In summer, from May to September, the pupæ emerge from the cocoons. They push about halfway up when the moth escapes. The male is smaller and more daintily colored than is the female.

The number of caterpillars per tree varies from one to seventy-five, and often, if left undisturbed, utterly girdle and so destroy the tree, working for the most part just beneath the earth. It is said by those best fitted to judge that a single county of California suffers a yearly loss of $100,000 from the attack of this insect. Happily it is not widely distributed in our State. I know it only in the counties immediately adjacent to the Santa Clara Valley. The fact that it has been taken high up in the Sierra Mountains and worked originally on a native plant (*Cerasus demissa*), of both ranges of our mountains from which it has migrated to our cultivated drupaceous plants, makes me feel sure that it can live and thrive in all our deciduous orchards, where stone fruits are grown, if once introduced. It is a curious and most fortunate circumstance, that the borer is not more widely distributed in the peach growing counties. The same peculiarity characterizes the Eastern borer in Michigan. It is a wonder, and a species of wondrous luck, that the Mexican orange maggot (*Anastrepha* (*Trypeta*) *ludens*, Leow.) has not gained lodgment in California orange groves, yet we do not and will not abate our hardest effort to keep it out. No more should we or shall we spare any pains to fence against this peach borer where it has failed to gain lodgment.

It is a dangerous foe to the fruit grower. No nursery should harbor it, no nurseryman send it forth, no inspector permit it to leave his county, no county commissioner permit its entrance or sale in his county.

Again, here, if anywhere, and surely here, the finding of any tree in a shipment wounded by this peach borer is sufficient cause for rejecting the entire shipment. As we have seen, the borers are often so minute that the keenest inspection will hardly detect them. They are too serious a pest for us to take any possible risk. Were I setting an orchard I would not buy trees if I had any cause for suspicion that any were attacked.

In Michigan, where I had much experience with the near congener of our peach borer, I found that early July was the time when the first moths emerged from the pupa stage. There, as here, the digging out process was the one and only method to successfully combat the borers. The oozing gum makes it easier to find the borers. The washes were not found reliable. The mounding of the trees with earth usually failed to give any very satisfactory results. There were four times in the year that digging out was practiced; twice in the fall and again as many times in the spring. A chisel and pruning knife were the tools used in this digging out process. Boys in the high school were secured to do the work. This frequent digging was required, as it was desirable to catch them as soon as their size attracts the eye, and to repeat the quest that those too small to be detected at any search would be captured as soon as they could be discovered. In this way the pest was really exterminated in some of the most important peach growing districts of the State. In orchard practice attention to detail "wins out"; this digging out, "in season and out of season," is an all-important detail.

There is a custom among some nurserymen of "puddling" the roots of nursery stock before shipping to protect them from drying out. In case of any trees subject to affection like drupaceous trees subject to attack of borers, apple trees which may harbor the woolly aphis, and almost all rosaceous trees and plants, and many others that furnish home and food at the root for the root gall nematode, etc., this puddling should be cause sufficient for refusing nursery stock thus treated. It makes it well nigh impossible to detect the pests. One of the largest and most cautious nurserymen of the State told me this past week that he never puddled any tree but the fig, which, so far as he knew, had no insect or other affection of the roots.

There are two excellent bulletins treating of Peach Borers, one that of Mr. Moulton, published by the Department of Agriculture, and that by Professor Slingerland of Cornell University.

THE CONTROL OF SCALES AND LICHENS ON DECIDUOUS TREES.

By G. E. Merrill.

Species and Distribution.

Whether or not the present year is to see a greater abundance than usual of the common scale pests of deciduous fruit trees in California is a question. Certainly, the European peach scale Lecanium (*Lecanium corni*), formerly known as the brown apricot scale, is particularly abundant in parts of the Sacramento Valley. This scale, the olive or black scale (*Saissetia oleæ*), the European pear scale (*Epidiaspis pyricola*), are all present in their customary abundance in the Santa Clara Valley. In Contra Costa County, in addition to the other common scales, the black and white scale (*Lecanium cerasorum*) is found over a larger area than ever before. The San Jose scale occurs this year in considerable quantities in the orchards of the cooler coast valleys and hills. In all the above named districts, and in others, lichens and mosses of

various kinds are thriving to a greater or less degree on nearly all the larger trees and shrubs.

Damage.

The amount and character of damage done by each of these pests vary. So far as known the European peach Lecanium and the olive or black scale do not of themselves seriously interfere with the growth of the tree or fruit unless present in exceedingly large numbers. The damage done by these species and others closely related consists rather in the smutting of the fruit by means of the fungus that develops in the honey-dew secreted by the scales. On the other hand, the European pear scale and the San Jose scale produce a toxic or poisoning effect on the sap of the trees they infest. These last two scales when abundant will kill all or part of the tree.

The direct damage done by the mosses and lichens themselves is not great as most of their food is taken from the air. They are, however, the source of a large amount of indirect loss, inasmuch as they form a shelter for some of the scale pests, especially the European pear scale. This insect seldom becomes abundant except on moss or lichen covered trees. On clean trees the scale is well controlled by ladybirds. The two spotted ladybird (*Chilocorus bivulneris*) is particularly effective at this work. The presence of a large quantity of mosses and lichens completely checks the work of the ladybirds and advertises to the close observer the fact that the owner is not a man who takes pride in the appearance of his trees.

Sprays.

The mosses, lichens and scales mentioned in this article, and nearly all the others liable to infest our deciduous trees, are best controlled by means of spraying while the tree is still dormant. Many formulas have been tried and recommended. Several of these formulas are effective. Among the most effective remedies may be named the lime-sulphur mixture and the crude and distillate oil emulsions.

The one that seems to the writer to be the most effective and cheapest is the crude oil emulsion made according to the following formula or some multiple thereof:

Fish-oil soap	5 pounds
Lye	1 pound
Crude oil	6 gallons
Water	43 gallons

The fish-oil soap may be made at home by the use of directions given on page 55 of the Bulletin.

To make the emulsion, dissolve the soap in about ten gallons hot water, add the lye, then place the mixture in the spraying tank and add 43 gallons water, then slowly pour in the crude oil, keeping the contents of the tank under constant agitation. Under no condition should the water be added after the oil. When this thing is done, a perfect emulsion does not result and free oil appears on top of the mixture. Crude oil, with an asphaltum base that tests from 16 to 22 degrees Baumé, gives excellent emulsions.

The crude oil emulsion should be used while the trees are dormant, and before the buds have begun to separate. In the application of this spray, as in others, thorough, careful work is essential for effective results. The pressure should be high; from 200 to 240 pounds per square inch, as a low pressure is not effective in driving the spray into the mosses and lichens. A somewhat coarse driving spray from an angular nozzle will be found advisable. Every portion of the tree, twigs, branches and trunk, should be thoroughly coated. The advantage of the crude oil emulsion over other sprays mentioned is that it is more effective, cheaper and has a stimulating effect on the tree.

Effective results in the control of the pests under discussion have been secured by the use of distillate oil emulsion either with, or without, the addition of caustic soda. The emulsion may be prepared at home according to the formula given on page 55 of the Bulletin, or may be purchased from dealers in insecticides. In making this spray mixture, from 9 to 12 gallons of the concentrated emulsion should be used to each 100 gallons of spray. The use of caustic soda should be avoided after the buds have swollen.

The lime-sulphur washes, either the commercial or the home made are also effective on some of the scales, particularly the San Jose scale. It does not have so lasting an effect on the lichens as do the emulsions, and its cost is also materially higher.

Time of Application.

The foregoing sprays may be most effectively applied in the latter part of February, provided the buds are not too well developed. The distillate oil emulsion without caustic soda may be used after the buds have begun to separate, or even after the petals have fallen.

PLANT LICE AFFECTING CITRUS TREES.

By E. O. Essig.

PART I.

This study of plant lice (*Aphididae*) was originally published by the author in the Pomona College Journal of Entomology in Vol. III—No. 4, December, 1911.

Owing to the fact that the above publication has but a limited circulation among the citrus growers of California, it has been thought best to republish the article in the Monthly Bulletin.

The descriptions of the different Aphids are somewhat technical, but they are necessary and important to those who are making a close study of insects, and should be of some value to the county commissioners and inspectors.

Owing to its length the article will be published in two parts. Part one to include the descriptions of the injurious plant lice, and part two the descriptions of the natural enemies and methods of controlling the plant lice.

We are indebted to the Pomona College Journal of Entomology for the free use of the illustrations herein contained.—Ed.

There has been much speculation in the minds of many of the citrus growers and horticultural commissioners in southern California regarding the plant lice which affect the citrus trees. In fact, the ignorance regarding these insects, as expressed by the secretary of the horticultural commissioner in a neighboring county, certainly justifies the pub-

lication of a study such as this is intended to be. At a recent meeting held in Los Angeles by the Los Angeles County Horticultural Society, for the purpose of discussing the topic, "Insect Pests and Methods for Their Control," it was emphatically argued by members of the Los Angeles Horticultural Commission that the Black Peach Aphis, *Aphis niger* Smith, was attacking certain orange groves in southern California. When it was said that the Black Peach Aphis did not work on citrus trees there was such a confusion created in the minds of all present that I do not wonder if many of the citrus growers, especially in the districts where entire peach orchards are now being uprooted because of that insect, are not afraid that the citrus trees may go next. Though this is an extreme and remote possibility, even under most ignorant direction, still it shows how little is actually known regarding these aphids, which are designated by the orchardists as small beetles, gnats, flies, etc., and it shows also how great the value of a thorough knowledge of them will be.

Practically every locality in which citrus trees are grown, has been visited, and extensive collections of plant lice made for the purpose of this study. Perhaps some of these insects have been passed unobserved, but all the common injurious forms are here presented, and comprise four genera and five species as follows: *Aphis cookii* n. sp., *Aphis gossypii* Glover, *Macrosiphum citrifolii* Ashmead, Green Peach Aphis, *Myzus persicæ* Sulz., and the Citrus Aphid *Toxoptera aurantiæ* Koch. All of these have been carefully drawn and described from fresh and living specimens so as to get accurate color notes and body shapes.

In connection with the following descriptions I have also worked up, as thoroughly as possible, all of the natural parasites and predaceous enemies which prey upon the plant lice and which are responsible for their not doing greater damage; in fact, these practically control all infestations on citrus trees, with the exception of sometimes a few localized cases during the early spring and summer months.

For the specific cases where the aphids are not controlled by natural enemies and where it is necessary to employ artificial means of control I have prepared spray formulæ, which are specially adapted for citrus trees, and which will usually bring immediate relief if applied as directed. It is sometimes very important to have these at hand, particularly in cases of heavy infection of very young trees, where considerable damage may be done in a very short time.

It will be my aim to continually improve this first article by adding descriptions of new aphids, natural enemies and better means of artificial control. I invite the aid of all growers and other interested parties and ask them to send specimens which have not been included here, and I shall be glad to make any determinations of plant lice, provided they are shipped in large quantities with the host plant in a strong box so that the natural color and body shape can be studied in connection with the anatomical characters.

Aphis cookii Essig.

WINGED VIVIPAROUS FEMALE (Figure 40 A).

1910 *Aphis gossypii* Glover-Essig, Pomona Jr. Ent. Vol. II, pp. 223-224.

Length of body not including style 1.75 mm., width of mesothorax 0.70 mm., greatest width of abdomen 0.78 mm., wing expansion 7.20 mm., rather large and robust form.

Prevailing Color—Dark gray or black with a whitish flocculence which makes it appear whitish. *Head*—Black or dark brown, nearly twice as wide as long, with rather large antennal tubercles, but these are not at all prominent. *Eyes*—Very dark red or brown, terete tubercles extending nearly at right angles to the eye-surface. *Antennae* (Fig. 40, D)—On small frontal tubercles, not as long as the body,

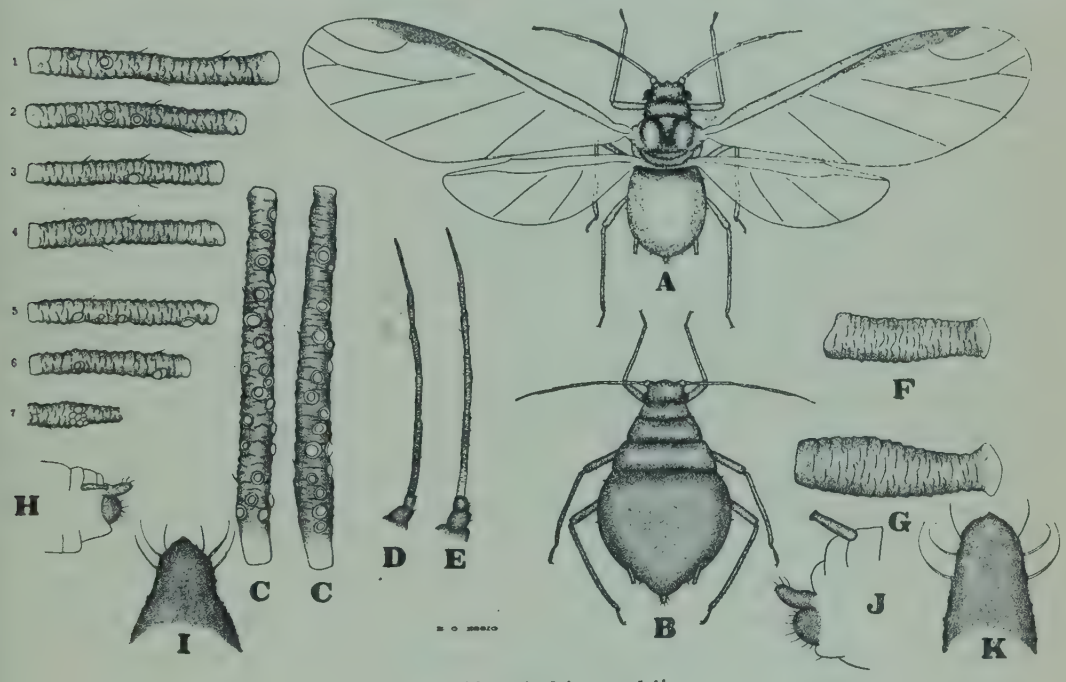

FIG. 40.—Aphis cookii.

reaching to the bases of the cornicles, very sparsely haired, dark throughout, imbricated; lengths of articles: I, 0.08 mm.; II, 0.08 mm.; III, 0.35 mm.; IV, 0.22 mm.; V, 0.22 mm.; VI, 0.44 mm. (spur 0.3 mm.); total 1.39 mm. It will be seen from the above that I and II are coequal, III longer than either IV or V, but shorter than VI; IV and V coequal. The sensoria are distributed as follows: Article III (Fig. 40, C, C) with from seventeen to twenty-eight large circular sensoria scattered over the surface; IV (Fig. 40, 1, 2, 3, 4) with from one to three large circular sensoria, which may be scattered at the base or near the apex of the article, but they are usually on the basal half; V with from two to three large circular sensoria (Fig. 40, 5, 6) and in some instances one small one as shown in drawing. There is usually but one sensorium. The small group in the nail-like process of article VI is shown in Fig. 40, 7. *Rostrum*—Reaching to second coxæ, with

dark base and tip. *Prothorax*—More than twice as wide as long; dark, with very small lateral tubercles. *Meso-* and *Meta-thorax*—Wide, black, with prominent muscle lobes. *Abdomen*—Well rounded, dull green or brownish-green, bearing a transverse row of quite long white flocculence on each segment (not shown in the cut), which may nearly cover the entire body. Anal plate (Fig. 40, H) dark, hairy, three small marginal tubercles on each side. *Cornicles*—(Fig. 40, F). Short, somewhat cylindrical, with wide mouth, base little wider than apex, narrowest just before the mouth, imbricated, black, longer than the style, length 0.16 mm. *Legs*—Moderately long and hairy, black or dark brown throughout. *Wings*—Large, hyaline. *Primary*—Length 3.3 mm., width 1.25 mm. Costal vein stout, dark brown; subcostal wide, brown; stigma long and narrow, widest at the base of the stigmal vein, from whence it narrows to a point at the wing margin, the opposite sides are nearly parallel, length 0.95 mm., width 0.16 mm., amber brown; stigmal vein arising three fifths the distance from the base of the stigma, strongly curved throughout first half and slightly curved throughout the apical half, rather long, brown or amber; first and second discoidals straight; third discoidal twice branched, first branch arising one third the distance from the base to the tip, short, parallel with the apical one third of the stigmal vein, brown arising very near to the tip of the first branch (three fourths the distance from the base to the tip), short, parallel with the apical one third of the stigmal vein, brown or amber. *Secondary*—Length 1.8 mm., width 0.65 mm.; subcostal vein curved downwardly just beyond the base of the second discoidal and then curves upwardly to original level to tip of the wing; first discoidal arising just beyond one fourth the distance from the base to the tip of the subcostal, slightly curved outwardly, does not touch the subcostal vein or the wing margin; second discoidal arising from the middle of the subcostal and nearly straight, does not touch subcostal vein, but extends to wing margin; all veins brown. *Style*—(Fig. 40 H and I). Bluntly ensiform, or conical, beset with stiff hairs, rough, dark, curving upward, length 0.12 mm.

APTEROUS VIVIPAROUS FEMALE (Figure 40 B).

Length of body not including style 2.2 mm., width of abdomen 1.3 mm.

A larger and more robust form than the winged female.

Prevailing Color—Very dark green or brown, covered with transverse rows of rather long white flocculence on the body, giving it a grayish appearance. Body gradually widening from head to the middle of the abdomen and then rounds off to the style, robust. *Head*—With slight frontal tubercles, much wider than long, dull green or brown. *Eyes*—Red. *Antenna* (Fig. 40, E)—On very slight frontal tubercles, much shorter than the body, very sparsely haired, dark throughout except the base of article III, imbricated. The lengths of the articles are as follows: I, 0.1 mm.; II, 0.07 mm.; III, 0.4 mm.; IV, 0.21 mm.; V, 0.21 mm.; VI, 0.4 mm. (spur 0.26 mm.); total 1.39 mm. With sensoria on

V and VI articles as in normal forms. *Rostrum*—Reaching just beyond second coxæ, amber brown with darker base and tip. *Prothorax*—Slightly wider than head, with small lateral tubercles. *Abdomen*—Well rounded. dull green, covered with flocculence, three small marginal tubercles on the sides. *Cornicles* (Fig. 40, G)—Incrassate, nearly vasiform, imbricated, widest in middle and narrowest just before the mouth, often appear cylindrical with swollen tip, black, length 0.2 mm. *Style*—(Fig. 40, J and K)—Conical or bluntly ensiform, rough, hairy, black, length 0.14 mm., shorter than the cornicles.

Young—Much lighter in color than the adults and almost destitute of the white flocculence.

Host—Orange trees, where it occurred in great numbers.

Locality—Collected by Horticultural Inspector C. H. Vary at Pomona, California. It has never been located anywhere else and can not even be found there just now.

Date of Collection—April 4, 1909. Serial number 36.

The general appearance of this insect with its short antennæ and cottony covering is not unlike that of one of the members of the genus *Lachnus* and was so recorded by me at the time it was first obtained. Strange to say, when first collected by Mr. Vary it occurred in such numbers as to nearly ruin the infested trees. Prompt measures were taken to hold the pest in check and it soon disappeared. Since then I have been unable to obtain fresh material. From the very beginning it did not appear to be *Aphis gossypii* Glover, but I thought it might be one of the various forms of that species and so described it as such. Since that time I have sent specimens to various of the authorities on this group and have received the following replies:

"Your letter of the 13th ult. at hand and I have gone over the slides you sent. I am returning them under separate cover and will say that those labeled *Aphis gossypii* are not that species. . . ."—H. F. Wilson, Oreg. Agrcl. Exp. Sta., March 2, 1911.

"I feel certain that the insect that you have figured as *Aphis gossypii* is quite wide from that species. This insect is a very abundant one in Colorado upon our cucurbitaceous plants, especially infesting the cantaloupe. I have also material from the cotton plant in Texas and am quite certain that we have the species correctly determined. . . ."—C. P. Gillette, Colo. Agrcl. Exp. Sta., June 9, 1910.

"*Aphis* sp.? No. 36.—It appears to be nearest related to *A. gossypii*, though there are too many sensoria in the third antennal joint."—Theo. Pergande, Bur. Ent., U. S. Dept. Agrcl., June 12, 1911.

Not being able to place this as an already described species, I have felt justified in calling it a new species, and have named it in honor of Prof. A. J. Cook of Pomona College, whose work for the upbuilding of the citrus industry in this State is well known throughout the entire country.

Aphis gossypii Glover.

1854 *Aphis gossypii* Glover, Pat. Off. Rept., p. 62.
1882 *Aphis citrulli* Ashmead, "Florida Dispatch," vol. I, p. 241.
1883 *Aphis cucumeris* Forbes, 12th Rept. Ent. Ill., pp. 83-91.

Winged Viviparous Female (Figure 41 A).

Length of body not including style 1.35 mm., width of mesothorax 0.42 mm., greatest length of abdomen 0.65 mm., wing expansion 5.10 mm. Very small form.

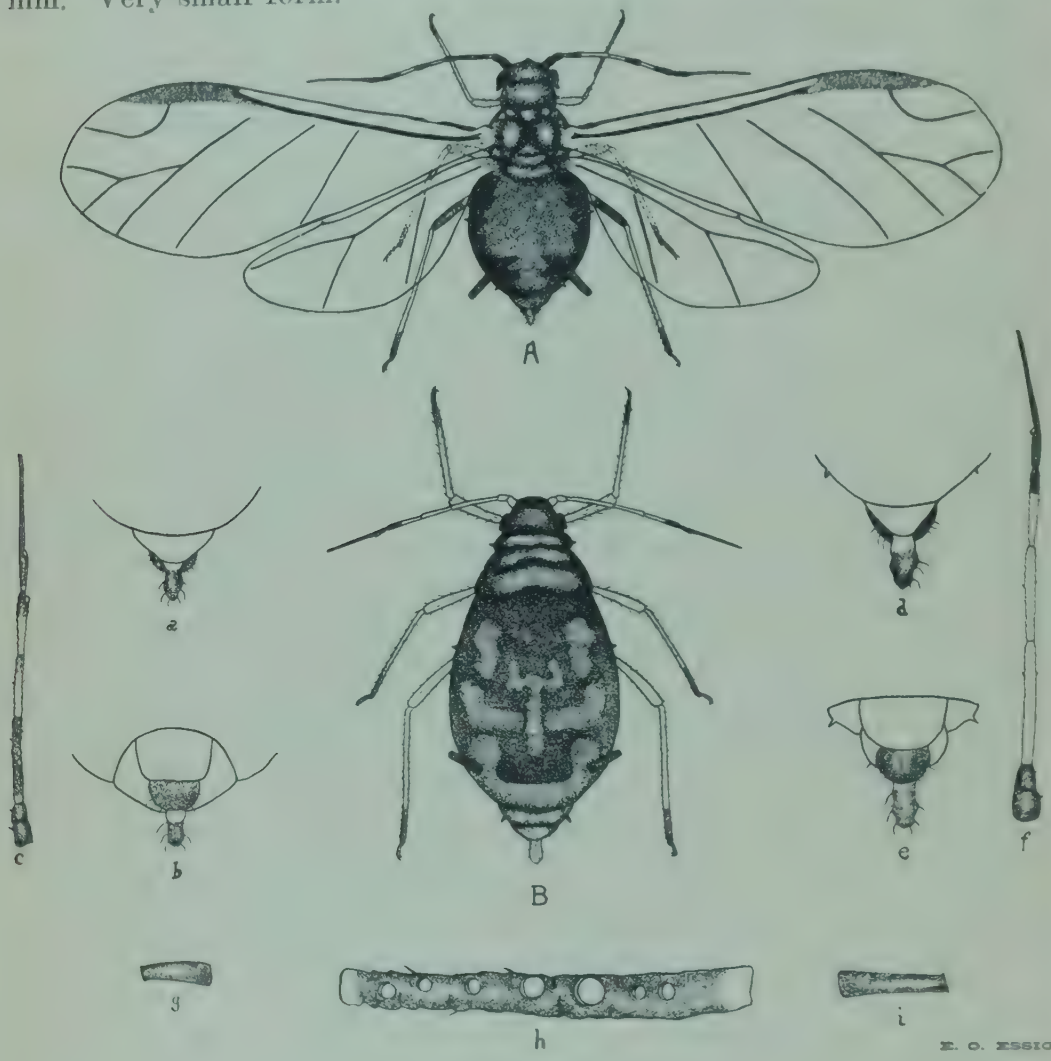

Fig. 41.—Aphis gossypii.

Prevailing Color—Dark, black or very dark green or brown. *Head*—Much wider than long, black. *Eyes*—Very dark red or brown. *Antennæ* (Fig. 41, c and h)—Arising directly from the head, not as long as the body, reaching to the bases of the cornicles, sparsely haired; articles I and II dusky, III with light base and remainder dusky, IV and V light yellow with apical halves dusky, VI dusky throughout; length of the articles: I, 0.07 mm.; II, 0.04 mm.; III, 0.22 mm.; IV, 0.17 mm.; V, 0.17 mm.; VI, 0.37 mm.; (spur 0.26 mm.); total 1.04 mm.; from seven

to eight large circular sensoria on article III (Fig. 41, h), remaining articles normal. *Rostrum*—Reaching to or slightly beyond third coxæ lemon yellow with the base and tip dusky. *Prothorax*—Slightly wider than the head, but no longer; black, with distinct lateral tubercles. *Meso-* and *Meta-thorax*—Black, with prominent muscle lobes. *Abdomen*—Smooth, dark green or greenish brown, with an irregular lighter area on the dorsum, ventral surface dull green, small lateral marginal tubercles extending from sides, anal plate (Fig. 41, a and b) dusky, hairy. *Cornicles* (Fig. 41, g)—Cylindrical, wider at base and gradually tapering to tip; imbricated, black, curved slightly outwardly in some specimens, length 0.2 mm. *Legs*—Normal, hairy, coxæ black, femora of first and second pairs light yellow, femora of third pair yellow with apical three fourths dusky, tibiæ yellow with dark tips, tarsi dark. *Wings*—Rather large for the size of the species, hyaline. *Primary*—Length 2.3 mm., width 0.95 mm.; costal vein dark and well defined; subcostal wide, yellow; stigma long and narrow, tapering from the base of the stigmal vein to a point at the tip, amber in color, length 0.65 mm.; first discoidal straight, second discoidal curved inwardly toward the body, third discoidal twice-branched and curved slightly inwardly, first branch arising near the middle of the vein, the second branch arising nearer the tip than the middle of the first branch—both of these branches curve toward the third vein. All veins are amber. *Secondary*—Length 1.5 mm., width 0.55 mm.; subcostal curved downwardly at the base of the second discoidal and then curves upwardly to point of wing; discoidals nearly straight. *Style* (Fig. 41, a, dorsal, and b, ventral)—Conical or nearly cylindrical, hairy, green, with dusky tip, length 0.11 mm.—a little more than half as long as the cornicles.

Apterous Viviparous Female (Figure 41 B).

Length of body not including style 1.8 mm., width of abdomen 0.9 mm. Larger than the winged form and more robust, although many are oblong in shape, not as robust as the apterous forms of *Toxoptera aurantiæ* Koch. Some slightly pruinose giving them a gray color.

Prevailing Color—Black or dark olive green. *Head*—Well rounded in the front, nearly as long as wide, black. *Eyes*—Dark red or brown. *Antennæ* (Fig. 41, f)—Not arising from frontal tubercles, but direct from the head, much shorter than the body—not reaching to the bases of the cornicles; articles I and II dark, III and IV light lemon yellow, V light lemon yellow with a dark tip, VI dusky throughout; lengths of the articles: I, 0.08 mm.; II, 0.06 mm.; III, 0.32 mm.; IV, 0.25 mm.; V, 0.21 mm.; VI, 0.35 mm. (spur 0.25 mm.); total 1.27 mm.; all articles sparsely haired; sensoria on articles V and VI normal. *Rostrum*—Reaching just beyond the third coxæ, lemon yellow with dark base and tip. *Prothorax*—Very short, with distinct lateral tubercle. *Meso-* and *Meta-thorax*—Narrow transversely. *Abdomen*—Smooth, dark green with irregular lighter markings on the dorsum and with small marginal tubercles on the sides, ventral surface dull green. Anal plate (Fig. 41, d, dorsal, and e, ventral)—Dusky, hairy. *Cornicles* (Fig. 41, i)—

Cylindrical, widest at base and gradually tapering to tip, imbricated, black, length 0.27 mm. *Legs*—Normal, coxæ dark, femora light yellow, tibiæ light yellow with dark tips, tarsi dark. *Style* (Fig. 41, d and e)—Conical or nearly cylindrical, hairy, dusky green to dark brown, length 0.13 mm.

Young—Dark green or brownish. Some are slightly pruinose.

Hosts—This insect has been taken in this locality only upon the tender growth of orange trees. Near Pomona it was found by the writer several years ago in great numbers feeding upon the tender shoots of young Valencia trees. At Santa Paula it has been found only upon the suckers of the Havana Seedling Sweet Orange.

This species is indeed a very extensive feeder and has been taken from over fifty different plants throughout the United States. It was originally found upon the cotton plant and has since proven a great melon pest. It is known by the common names "Cotton Aphis" and "Melon Aphis." In this particular locality there are numerous melon vines growing near orange groves which have been infested with the louse but I have never yet found a single vine infested with it. I recently received a shipment of eight distinct species of plant lice from Imperial County, where the melons suffer from their depredations, but none of them proved to be this species, although this does not prove that it does not exist in that locality.

Locality—On citrus trees throughout this State and also reported on various other plants. Taken in Orange, Los Angeles, San Bernardino and Ventura counties by the writer.

Date of Collection—This species, like *Toxoptera aurantiæ* Koch, is most abundant during the early spring months from February to June. Collected in large numbers at Santa Paula, May 17, 1911. Serial number 6.

Natural Enemies—Subject to the attacks of the same natural enemies as are described under *Toxoptera aurantiæ* Koch.

In the Pomona College Journal of Entomology, Vol. I, pp. 47-48, 1909, I described this insect as *Aphis citri* Ashmead. In the same Journal, Vol. II, pp. 223-224, 1910, the species described as *Aphis gossypii* Glover has proven to be a new and distinct species and is herein described as *Aphis cookii* n. sp.

Macrosiphum citrifolii (Ashmead).

1882 *Siphonophora citrifolii* Ashmead, Can. Ent. Vol. XIV, p. 92.

Winged Viviparous Female (Figure 42 A).

Length not including style 2.2 mm., width of mesothorax 0.7 mm., greatest width of abdomen 0.9 mm., wing expansion 9.0 mm. A large green louse greatly resembling the Pea and Rose Aphids.

Prevailing Color—Bright pea green, shiny. *Head*—Slightly wider than long, amber to pinkish yellow in color, with rather large antennal tubercles. *Eyes*—Red. *Antenna*—On rather large tubercles, longer than the body, with very few hairs, articles I and II dusky green, III dusky amber with extreme base light, IV, V and VI dusky

throughout; the lengths of the articles are as follows (although these vary greatly): I, 0.14 mm.; II, 0.08 mm.; III, 0.74 mm.; IV, 0.7 mm.; V, 0.67 mm.; VI, 1.0 mm. (spur 0.76 mm.); total 3.33 mm. There are from fourteen to fifteen large circular sensoria in a row on article III and usual number on V and VI. *Rostrum*—Reaches nearly to the second coxæ, dark at tip only; remainder, color of body. *Prothorax*—Much wider than long, light green in color, without lateral tubercles. *Meso-* and *Meta-thorax*—Dorsum light green with the

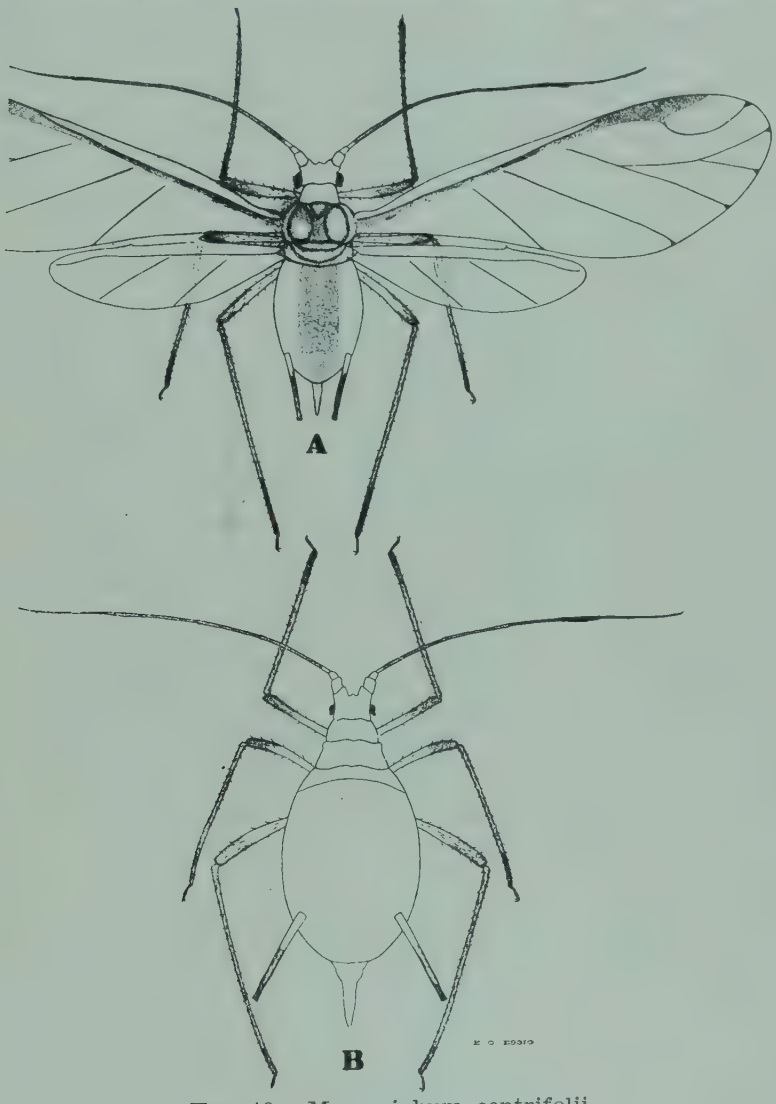

FIG. 42.—Macrosiphum centrifolii.

muscle lobes pinkish or amber, ventral side darker on middle. *Abdomen*—Long and regularly rounded, light shiny green with a darker green longitudinal band on the middle of the dorsum, all green ventrally, may, or may not, have red spots on dorsum. *Cornicles*—(Fig. 43 *g*). Cylindrical, long, restricted before apex, with mosaic markings in the restricted area, nearly twice as long as style, color of body with the apical two thirds dusky, length 0.7 mm. *Legs*—Long and slender, normally haired, coxæ color of body, femora green with apical half

dusky, tibæ dusky throughout, tarsi dark. *Wings*—Hyaline. *Primary*—Length 4.2 mm., width 1.45 mm.; veins ending in dusky spot at wing margin; costal well defined, but narrow, light yellowish green; subcostal wide, light yellowish green; stigma long and narrow, light yellowish green, stigmal vein well curved and arising from the stigma at its widest point (just beyond the middle from the body); first and second discoidals nearly straight; third discoidal nearly straight, first branch slightly curving downward, second branch arising near the middle of the branch. All veins except those already specified are amber in color. *Secondary*—Length 2.4 mm., width 0.65 mm.; subcostal curved upward near the tip, first and second discoidals straight and arising one third and two thirds respectively, the distance from base to tip of subcostal; amber. *Style*—(Fig. 43 m). Ensiform, hairy, color of body or slightly dusky, length 0.32 mm.

Apterous Viviparous Female (Figure 42 B).

Length of body not including the style 2.6 mm., greatest width of abdomen 1.35 mm. Larger and more robust than the winged form.

Prevailing Color—Bright, shiny green. *Head*—Yellow. *Eyes*—Red. *Antennæ*—On rather prominent frontal tubercles (more prominent than those of the winged form), longer than the body, slightly hairy, articles I and II color of the head, III dusky with light base, remaining articles dusky throughout, the lengths of the articles are as follows: I, 0.12 mm.; II, 0.08 mm.; III, 0.79 mm.; IV, 0.65 mm.; V, 0.59 mm.; VI, 1.2 mm. (spur 0.86 mm.); total 3.25 mm.; there are three or four circular sensoria on article III (Fig. 43 b). *Rostrum*—Reaching just beyond second coxæ, dark at tip only. *Thorax*—Widening from the prothorax to the abdomen, yellowish green. *Abdomen*—Smooth, shiny green, with or without red dorsal spots. *Cornicles*—Same shape as those of the winged form, basal one third or half green with remainder dusky, length 0.97 mm. *Style*—(Fig. 43 n). Ensiform, hairy, green with margins slightly dusky, length 0.6 mm.

Young—Young are green and greatly resemble the adults in all characters.

Host—Found abundantly feeding on young seedling orange trees and upon the tender shoots and suckers of old seedling orange trees. Not taken on Valencia trees or on lemon trees, although it is not improbable that this insect does feed upon them as well as upon the seedling trees. The young shoots and buds may become so badly infested as to be entirely killed in a few weeks and care must be taken to keep this insect in check. Due to its green color it is seldom noticed until the twigs are beginning to show an unhealthy color.

Locality—Santa Paula, Cal. This insect has also been collected from nearly every citrus-growing section in southern California. Wm. Davidson reports this species from Lindsay, Tulare County, Cal. (Jr. Ec. Ent. III, p. 380, 1910).

Date of Collection—April 7, 1911. Serial number 25.

In 1880 Wm. Ashmead described several forms under the heading of this insect, some of which were certainly not of this species, but were of the species *Aphis gossypii* Glover. His description is as follows:

"From observations made this year I find that from an egg laid by a fall oviparous female, which I described as follows:

" '*Young*—Length .02 inch. Dark greenish brown, with dark eyes and glassy white antennæ and legs.

" '*Male*—Length .04 inch. Color brown and brown-black; antennæ brown, legs pale or yellowish, posterior femora slightly shaded above with brown or black; feet reddish; nectaries shorter than in female; wings hyaline, stigmal spot pale. These are rare among the first broods, and afterwards almost, or entirely, disappear.

" '*Female*—Apterous, length 0.05 to 0.06 inch. Broadly ovate. Dark brownish-black. Head between antennæ reddish; antennæ seven jointed, pale yellowish, apical ends of joints, three, four and five brown, six shortest, seven long, setaceous; legs pale yellow, latter two thirds of the femora brownish or blackish, tips of tibæ and claws brown; nectaries slightly thickest at base, black and cylindrical, cauda distinct.

" '*Winged Viviparous Female*—Length 1.06 inch. Color black and shining; eyes red-brown, tubercles of antennæ black, vertex of head reddish; rostrum reaching back of middle coxæ; antennæ not quite reaching to tip of abdomen; abdomen variable, brown-black, brown or olive-green; wings hyaline; stigma rather broad, brown, obliquely sharpened to a point at outer edge towards apex; stigmal vein strongly curved, dark; three oblique veins, the third forked; hind wings with two oblique veins in all specimens but one, nectaries long, cylindrical and black; cauda long and recurved, dark.

" 'I have watched these viviparous females breed on my orange trees and the rapidity with which this is done is simply astonishing. In a few days broods upon broods, or young colonies, seem to exist on all the tender new leaves and shoots, and still the parthenogenetic young keep coming. Verily, if it were not for the chalcid flies, ichneumons and other parasites, they would be the death of the trees. By the middle of March a change takes place in the broods. The young differ from their parents in shape, color and size. So different are they as to discredit belief, and had I not watched them breeding day by day on my orange trees, I should have felt justified in describing them as a distinct species. They are undoubtedly a dimorphic form, and I give below a description:

" '*Dimorphic, Viviparous, Apterous Female*—Length, 0.08 to 0.09 inch. Elongate; color of a uniform pale pea-green with more or less of a longitudinal shading of darker green on the dorsum, with the surface more or less corrugated; eyes bright red, with a prominent facet or ocellus springing out from hinder edge of same, giving it a tooth-like appearance; antennæ VII jointed, pale glassy green, in mature specimens the tip from the fifth joint is reddish; legs of the same uniform pale green; cauda small, conical. Beak does not quite reach to tip of middle coxæ.'

"The winged form agrees in every respect with the above description,

and can only be distinguished by having wings, the veins of which are very pale. These are rare, the majority being wingless.

"The mature viviparous female continues breeding and can often be found surrounded by from twenty to thirty pale green young; occasionally a brown one will be found among them. These continue breeding for several generations, ultimately giving place to the original type, and by the last of April none can be found. Why this change of form occurs is yet a mystery, and needs further investigation. Towards the end all seem to be parasitized by a *Trioxys, T. testaceipes* Cresson, which thoroughly eradicates them." Wm. H. Ashmead, Can. Ent. XIV, p. 88, 1882.

For no little time *Siphonophora citrifolii* Ashm. was considered a distinct species, but with the study of *Aphis gossypii* Glover it was learned that many of the above dimorphic forms were of this latter species and that after all Ashmead had not described a new species at all, but had redescribed *Aphis gossypii* Glover. This is what Theodore Pergande writes concerning *Aphis gossypii* Glover:

"In 1880 Mr. Wm. Ashmead redescribed this species in his pamphlet on 'Orange Insects,' under the name of *Siphonophora citrifolii*, which he found to be infesting his orange trees, without being aware that the same insect infests also cotton and had been described previously.

"Again in 1882, Mr. Ashmead, in a paper on the 'Aphididæ of Florida' in the Canadian Entomologist (Vol. XIV, p. 91), in discussing dimorphism among insects, besides reproducing his original description, makes the serious mistake of describing on page 92 another species as a dimorphic form of his *citrifolii*, which, however, according to the characters given in this description, is neither a true *Aphis* nor a *Siphonophora*, but appears to belong to the genus *Rhopalosiphum*. Mixed colonies of closely related and other species of aphids are frequently found infesting the same plant at the same time, which, however, does not indicate dimorphism." Insect Life, Vol. 7, pp. 310-311, 1895.

No doubt Mr. Pergande was referring to the description of the dimorphic, viviparous, apterous females as described by Mr. Ashmead and this is without doubt the *Siphonophora citrifolii* of Ashmead. Although this may not be the insect which he originally described under that name, he, nevertheless, describes it as a dimorphic form and his description of this is adequate to decide that the *Macrosiphum* found on citrus trees in this state is the same as the *Siphonophora citrifolii* described by Ashmead. In spite of the fact that this species has been regarded, by many, as a synonym of *Aphis gossypii* Glover, this so-called dimorphic form is a good and distinct species and I trust that this description and the accompanying drawings shall serve to give it a proper place in the literature of the family Aphididæ.

The species resembles in a number of ways the Rose Aphid (*Macrosiphum rosæ* Linn.) and the Pea Aphid (*Macrosiphum destructor* Johnson) and might easily be taken for either. Figure 43 shows a comparison of the antennæ, cornicles and styles of these three species. It will be seen that the number of sensoria on the third antennal article of the winged

female vary greatly, there being more than twice as many on *M. rosæ* than on either of the other two; more on *M. destructor* than on *M. citrifolii*. The third antennal article of *M. citrifolii* and *M. destructor* have three or four sensoria each, while there are thirteen or fourteen on the third article of *M. rosæ*. The third article of *M. rosæ* is longer than that of *M. citrifolii*, while that of *M. destructor* is longer than either. The cornicles of *M. rosæ* and *M. citrifolii* have a restriction at the tip with a mosaic figure in the restricted area, while the cornicles of *M.*

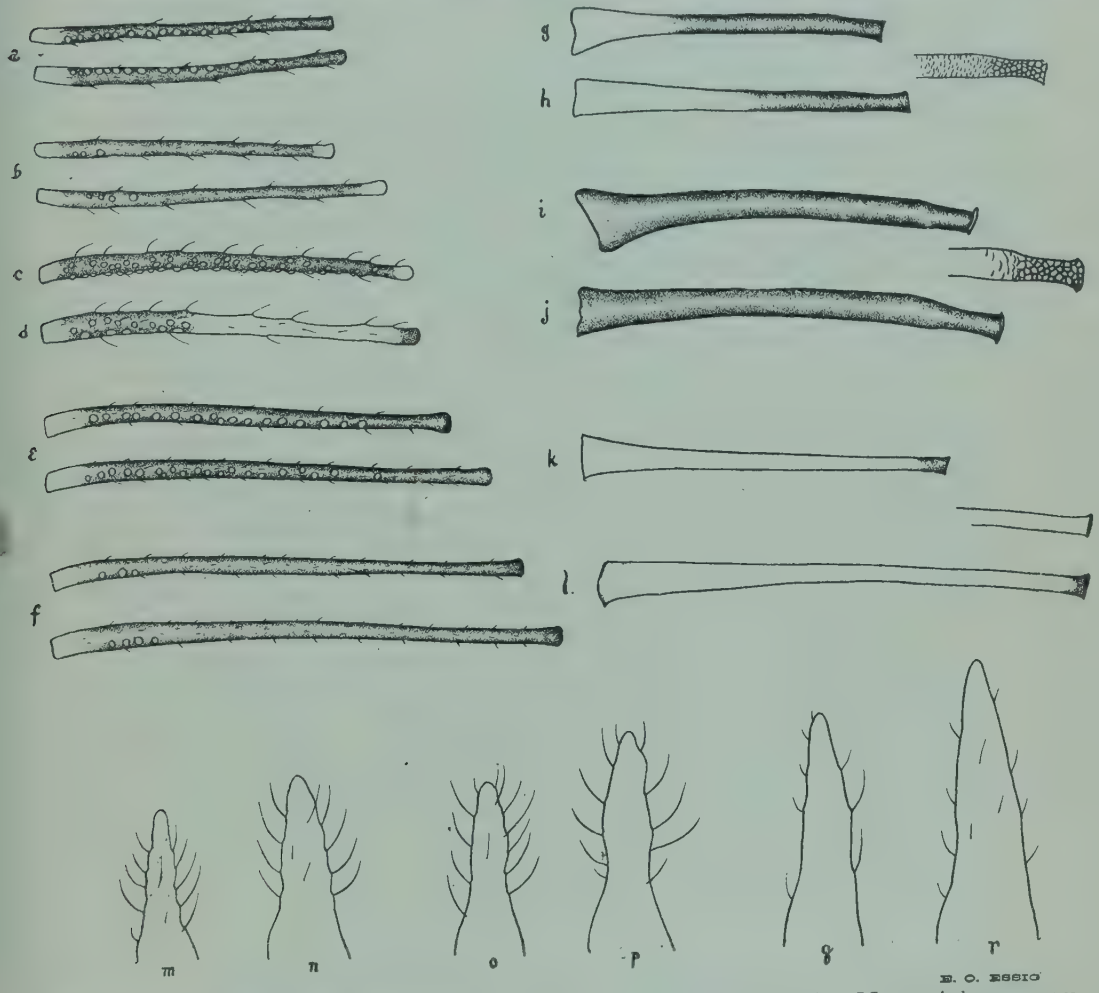

FIG. 43.—Details of Macrosiphum citrifolii (a, b, g, h, m, n); Macrosiphum rosæ (c, d, i, j, o, p); Macrosiphum destructor (e, f, k, l, q, r).

destructor are not restricted near the tip. Those of *M. rosæ* are dusky throughout, those of *M. citrifolii* are dusky on the apical half or two thirds, while those of *M. destructor* are dusky only at the tips. The styles of *M. citrifolii* are the smallest, of *M. rosæ* next in size (both of these are quite hairy) while those of *M. destructor* are much larger and are nearly destitute of hairs. The general appearance of *M. rosæ* is also easily told by the rosy forms and by the dark legs, the black markings of the head, thorax, and abdomen. Neither of the latter forms have these characters, except the darkened areas on the legs and these are much fainter.

Natural enemies—*Macrosiphum citrifolii* Ashm. is very effectually held in check in California by the predaceous ladybird beetles, *Coccinella californica* Mann, *Hippodamia convergens* Guer. and *Coccinella abdominalis* Say and by the larvæ of the Syrphid Flies *Syrphus americanus* Wied., *Allograpta obliqua* Say, and *Lasiophthicus pyrastri* L.

I am indebted to Mr. John June Davis for his aid in the determination of this species.

Myzus persicae (Sulzer) Passerini.

GREEN PEACH APHIS.

1761 *Aphis persicæ* Sulzer, Kenz, Insect P. 105.
1843 *Aphis dianthi* Schrank, Fauna Boica, II.
1843 *Aphis persicæ* Kalt., Mon. Pflz., pp. 93-94.
1847 *Aphis persicophila* Rondani, Ann. Sci. Nat. Bolog. 337-432.
1857 *Rhopalosiphum dianthi* Schrank, Koch, Die Pflz., p. 42.
1857 *Aphis institutiæ* Koch, Die Pflz., pp. 58-59.
1860 *Myzus persicæ* Pass., Gali Afidi.
1867 *Aphis persicæcola* Boisduval, Mon. Aley.
1876 *Myzus persicæ* Sulz.-Buckton, Mo. Brt. Aphid. I. 178.
1879 *Myzus achyrantes* Monell, Bull. U. S. Geol. Survey, V. I, p. 18.
1880 *Rhopalosiphum dianthi* Schr., Thos. 8th Rept. Ent. Ill., p. 80.
1880 *Myzus persicæ* Sulz., Thomas, 8th Rept. Ent. Ill., p. 76.
1886 *Myzus malvæ* Oestlund, Iist. Aphid. Minn., p. 31.
1908 *Myzus persicæ* Sulz., Taylor, Jr. Ec. Ent., I, 83.
1908 *Myzus persicæ* Sulz.-Gill. and Taylor, Bull. 133-134 Colo. Exp. Sta.
1908 *Myzus persicæ* Sulz.-Gillette, Jr. Ec. Ent. I, 359.
1909 *Myzus persicæ* (Sulz.), Fullaway, Ann. Rept. Hawaii Agrcl. Exp. Sta., 28-29.
1910 *Myzus achyrantes* (Monell), Williams, Aphid. Nebr., p. 63.
1910 *Rhopalosiphum dianthi* (Schrank), Williams, Aphid. Nebr., p. 69.

SPRING MIGRANT.

WINGED VIVIPAROUS FEMALE (Figure 44 A).

Length of body 1.9 mm., width of mesothorax 0.5 mm., greatest width of abdomen 0.82 mm., wing expansion 6.8 mm.

Prevailing Color—Green with dark dorsal markings. *Head*—Dark with lighter line at base, nearly as long as broad, with prominent, approximate, frontal tubercles. *Antennæ*—(Fig. 44 G). Gibbous on the inner basal sides, longer than body, dark except base of article III, sparsely hairy, lengths of articles: I, 0.1 mm.; II, 0.08 mm.; III, 0.58 mm.; IV, 0.43 mm.; V, 0.30 mm.; VI, 0.7 mm. (spur 5.2 mm.); total 2.19 mm.; at least twelve sensoria on article III. *Rostrum*—Reaching to or nearly to second coxæ, light with apical half dark. *Prothorax*—Black or dark with light band at central base and lateral basal corners light. *Meso-* and *Meta-thorax*—Shiny black. *Abdomen*—Green, brownish, or amber with darker dorsal markings as shown in drawing, ventral surface dusky.

Cornicles—(Fig. 44 E). Cylindrical or slightly clavate, reaching beyond tip of abdomen, dark, length 0.42 mm., width at base .05 mm., greatest

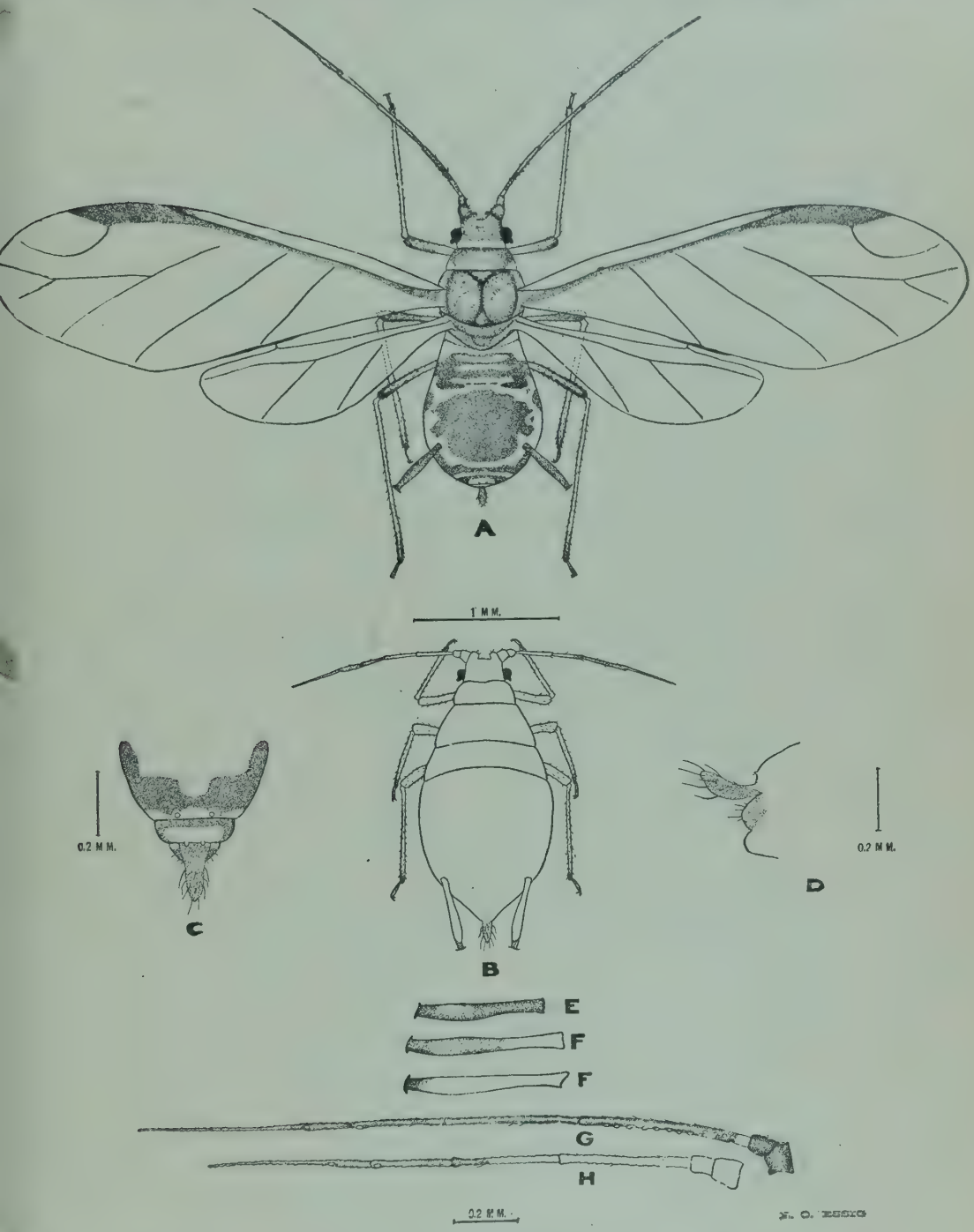

FIG. 44.—Myzus persicæ.

A, winged viviparous female; B, apterous viviparous female; C, pygidium of winged female, dorsal aspect; D, pygidium of apterous female, lateral aspect; E, cornicle of winged female; F, cornicle of apterous female; G, antenna of winged female; H, antenna of apterous female.

width 0.065 mm.; in some cases there is a light spot on the apical half which does not quite reach to the apex. *Legs*—Normal, coxæ light green; femora of prothoracic legs with apical half dusky, of the second

and third pairs the apical two thirds dusky; tibiæ with dark tips: tarsi dark. *Wings*—Normal, hyaline. *Primary*—Subcostal vein wide, dusky; stigma long and narrow, dusky; veins amber brown (see drawing), length 3.2 mm., width 1.2 mm. *Posterior*—Normal, length 1.8 mm., width 0.53 mm. *Style*—(Fig. 44 C). Ensiform or nearly conical, sickle-shaped, dusky, length 0.2 mm.

Apterous Viviparous Female (Figure 44 B).

Length of body 1.8 mm., greatest width of abdomen 0.95 mm.

Prevailing Color—Bright yellowish green, shiny throughout. *Head*—Nearly as long as wide, with very prominent approximate and somewhat gibbous, frontal, antennal tubercles. *Eyes*—Red. *Antennæ*—(Fig. 44, II). On prominent tubercles, first article somewhat gibbous, reaching to base of the cornicles, articles I, II, III and basal two thirds of IV light yellow, remainder dusky, lengths of articles: I, 0.09 mm.; II, 0.08 mm.; III, 0.43 mm.; IV, 0.34 mm.; V, 0.21 mm.; VI, 0.53 mm. (spur 0.38 mm.). *Rostrum*—Reaching to second coxæ, light with dusky tip. *Abdomen*—Smooth, light green, anal plate dusky. *Cornicles*—(Fig. 44, FF). Slightly clavate, light green with apical two thirds or but one fifth dark, reaching beyond tip of style, length 0.5 mm. *Legs*—Light green throughout with dark tarsi. *Style*—(Fig. 44, D). Conical, sickle-shaped, length 0.2 mm., light green.

This species is one of the most widely distributed and most variable of the entire family. It presents a number of distinct forms, each of which has been described as a separate and distinct species, causing much confusion in the literature of the family *Aphididæ*. Perhaps no one has worked it out more thoroughly than has Prof. C. P. Gillette of the Colorado Agricultural Experiment Station. In the Journal of Economic Entomology, Vol. I, pp. 359-362, may be found his full descriptions. He separately describes the following forms: Young Stem-Mother, Adult Stem-Mother, Apterous Viviparous Female, Spring Migrant, Winged Viviparous Female, Fall Migrant, Oviparous Female, and Male. Of these I have described the Spring Migrant and the Apterous Viviparous Female, the forms most common in this locality. For the full description see his article.

Hosts—I have obtained this species on citrus trees (Orange and Lemon), Potatoes, *Malva parviflora* L., and Tomatoes. It has also been reported as feeding upon the following plants: *Amsinckia spectabilis* F. & M., *Brassica oleracea* (Cabbage, Cauliflower), Celestial pepper (*Capsicum annum* var. *abbreviatum* Fing.), *Chrysanthemum indicum* L., *Cynoglossum* sp., Carnation (*Dianthus caryophyllum* L.), English Ivy (*Hedera helix* L.), Plum (*Prunus domestica* L.), Peach (*P. persica* B. & H.), Groundsel (*Senecio vulgaris* L.), *Sonchus asper* Vill., *Sonchus oleraceus* L., Nettle (*Urtica urens* L.), *Prunus amygdalus* Cherry (*P. cerasus* L.), German Ivy, *Prunus insititia*, *Malva rotundifolia*.

Locality—Taken by the writer in many parts of Southern California, at Claremont, Santa Ana, Santa Paula and Pomona. Date of collection—April 14, 1911. Serial number 22.

Note.—I am indebted to Mr. J. T. Monell for the specific determination of this species.

Toxoptera aurantiae Koch.

CITRUS APHID.

1857 *Toxoptera aurantiæ* Koch, Pflanzenlause, pp. 254-255.
1880 *Toxoptera aurantiæ* Koch-Buckton, Mon. Brit. Aphid, p. 135.
1910 *Toxoptera aurantiæ* Koch-Fullaway, Rept. Hawaii. Agrcl. Exp. Sta., pp. 341-342, for 1909.

WINGED VIVIPAROUS FEMALE (Figure 45 A).

Length of body not including style 1.6 mm., width of the mesothorax 0.55 mm., greatest width of abdomen 0.75 mm., wing expansion 6.5 mm. A small black form very common on Citrus in this State.

Prevailing Color—Black, shining. *Head*—Narrow, but wider than long, black, with inconspicuous frontal tubercles. *Eyes*—Very dark red, almost brown. *Antennæ*—(Fig. 45, D). On inconspicuous frontal tubercles, longer than the body, but not reaching to tip of style, slightly hairy, articles I and II dark throughout, III, IV and V all transparently light or amber with dusky tips, VI amber with dusky band at nail-like process and at the tip. The lengths of the articles are as follows: I, 0.1 mm.; II, 0.08 mm.; III, 0.37 mm.; IV, 0.31 mm.; V, 0.31 mm; VI, 0.52 mm. (spur 0.42 mm.); total 1.69 mm.; article III (Fig. 45, G) has from six to eight large circular sensoria, IV (Fig. 45, H) has one large circular sensorium three fourths the distance from the base to the tip, V has a large circular sensorium near the tip, VI has the usual number of sensoria in the nail-like process. *Rostrum*—Reaching just beyond second coxæ, light yellow with dark base and tip. *Prothorax*—Twice as wide as long, shiny black, with distinct lateral tubercles. *Mesothorax*—Shiny black, muscle lobes prominent, making the mesothorax much higher than the other part of the body. *Metathorax*—Narrow transversely, black. *Abdomen*—Well rounded and smooth, shiny black or very dark brown with several small lateral tubercles on the margins. *Cornicles*—(Fig. 45 C). Short, cylindrical, widest at base and narrowest at tip, with inconspicuously rimmed mouth, imbricated, black, length 0.2 mm., usually carried at right angles to the main axis of the body. *Legs*—Rather large, hairy; coxæ black, femora of fore-legs dark at tip only; femora of middle and hind legs amber with all but extreme bases black; tibiæ amber with bases and tips dark; tarsi dark. *Wings*—Rather large and hyaline. *Primary*—Length 3 mm., width 1.1 mm.; costal vein narrow and well defined, brown; subcostal wide and dark; stigma, the most characteristic feature of this insect, is very black and can be readily distinguished by the naked eye, long and narrow with the longest sides parallel, pointed at the tip, length 0.1 mm., width 0.15 mm.; stigmal arising near tip of stigma, well curved; first discoidal straight, light brown; second discoidal curved slightly inwardly, light brown; third discoidal once-branched, the branch arising near the middle of the vein (slightly nearer the tip from the middle), light brown. *Secondary*—Length 1.7 mm., width 0.5 mm.; subcostal extending to tip of the wing, curved upwardly between discoidals, downwardly just beyond base of the second discoidal, and thence upwardly to the tip; veins light brown. *Style*—Conical, hairy, black, length 0.1 mm., half as long as the cornicles.

Apterous Viviparous Female (Figure 45 B).

Length not including the style 1.65 mm. or slightly longer, greatest width of the abdomen 1.25 mm. A dark robust form somewhat larger than the winged individuals.

Prevailing Color—Velvety black, may or may not be shiny, some forms are slightly brownish-black. *Head*—Black, much wider than long.

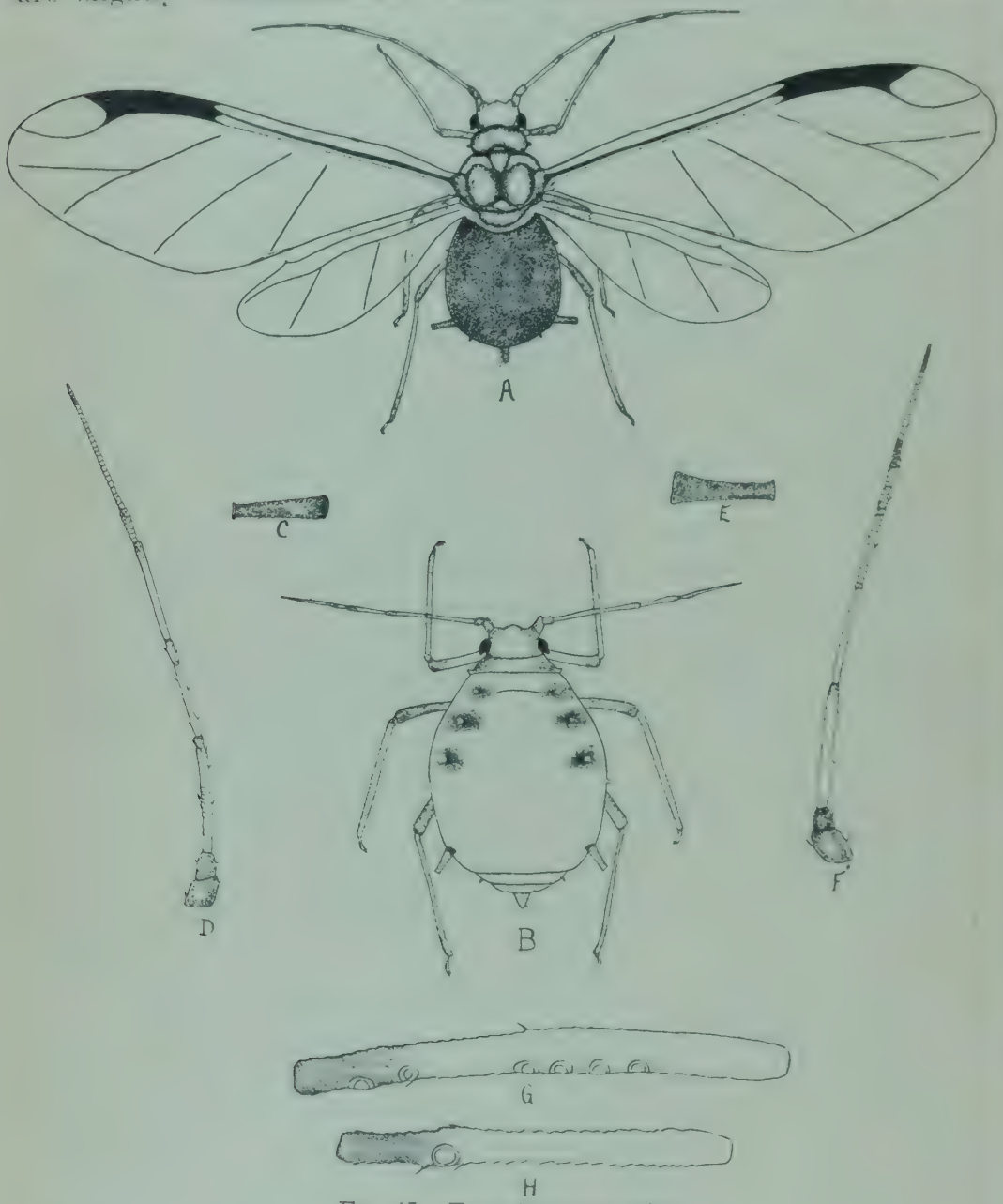

Fig. 45.—Toxoptera aurantiæ.

Eyes—Dark brown. *Antenna*—(Fig. 45 F). On inconspicuous frontal tubercles, reaching to the bases of the cornicles, slightly hairy, articles I and II color of the body, III, IV and V light yellow with dusky tips, VI light with dark band at nail-like process and dusky tip, lengths of the articles: I, 0.1 mm.; II, 0.07 mm.; III, 0.37 mm.; IV, 0.31 mm.; V,

0.31 mm.; VI, 0.45 mm. (spur 0.36 mm.); total 1.61 mm.; circular sensorium at apex of article V and usual ones in the nail-like process. *Prothorax*—With lateral tubercles at the base. *Meso-* and *Meta-thorax*—Not distinctly defined. *Abdomen*—Robust, smooth with lateral depressions near front margins, two marginal tubercles on each side, black or dark brown. *Cornicles*—(Fig. 45 E). Cylindrical, widest at base and gradually tapering to tip which is slightly rimmed, imbricated, black, length 0.2 mm. *Legs*—Normal, hairy, colored as in the winged form. *Style*—Conical, much wider at base than at apex, hairy, black, half as long as cornicles, 0.1 mm.

Young—The young apterous forms are from dull brown to black, while the nymphs are reddish brown.

Hosts—This species settles in great colonies on the tender twigs of orange and lemon trees and may entirely destroy the new top on a young tree. They also feed upon the undersides of the leaves of suckers and tender shoots of old trees. In not a few cases old, tough leaves are attacked by this species. The presence of the insect upon the older leaves is usually recognized by the curling and twisting of the foliage so as to form a place of protection for them on the insides of the cup-shaped leaves. While this insect has been found feeding on Orange, Citron and Camellia in Europe and on *Pelea, Straussia* and *Coffea* in the Hawaiian Islands, I have been able to find it only upon citrus trees in this locality, where it seems to exist during the entire year.

Locality—Throughout the entire southern part of California. Taken by the writer in San Diego, Orange, San Bernardino, Los Angeles and Ventura counties. Wm. Davidson also reports its at San Jose.

Date of Collection—Occurs in this locality during the spring and early summer months in abundance. Collected April 3, 1911, when most numerous. Serial number 14.

This species is easily mistaken for another small black aphid working in a similar manner and nearly always associated with it on seedling trees, *Aphis gossypii* Glover. It is easily distinguished from *A. gossypii,* with the unaided eye, by the black stigma on the primary wings as referred to above, and most easily distinguished under the microscope by the third discoidal vein being but once branched instead of twice as in *A. gossypii.*

Natural Enemies—This insect is most effectually held in check by the two internal parasites and by the larvæ of the large Syrphid Fly, *Lasiophthicus pyrastri* L., although the larvæ of the *Syrphus americanus* Weid., and of *Allograpta obliqua* Say, play an important part in this. Of the ladybird beetles, *Coccinella californica* Mann. is the most important enemy here.

Mr. John June Davis, Mr. J. T. Monell, Prof. Theo. Pergande and Professor Wm. Davidson have aided me much in the determination of this species.

THE VALUE OF AGRICULTURAL RECORDS.

By R. S. Vaile, Horticultural Commisisoner of Ventura County.

During the past few years many great advancements have been made in the efficiency of agricultural pursuits. The dairy business throughout the world has been highly improved by the elimination of the unprofitable cow. The corn yield of the middle west has been increased by the selection of seed corn that produces better ears. The wheat crop of California has been bettered by the choosing of better varieties. One of the most interesting experiments which have resulted in increased efficiency was performed upon shade grown tobacco in Connecticut. The tobacco growers supposed that they were growing one variety of tobacco which should have been the best of wrapper tobacco. For some reason only a small per cent of the crop was fitted for that purpose, and the industry was about to be abandoned when the United States Department of Agriculture sent Mr. A. D. Shamel to investigate the problem. He found that there were as many as forty varieties of tobacco—each slightly different from the others—and that only two or three were good for wrappers. By careful selection he was able to obtain a fine strain, and the industry was raised to a highly profitable plane.

These various improvements could not have been effected without accurate record-keeping from which practical conclusions might be drawn. Such record-keeping is of great value to all agricultural pursuits. There is just as much opportunity to improve the bean crop as there was the corn crop, and, in fact, any of the farm crops may be greatly increased.

In orchard practice even greater things are promised through record-keeping. The New York Experiment Station has recently published the results of a fifteen-year experiment with various fertilizers on an apple orchard. The only conclusion open is that in that particular variety no fertilizer is necessary for the maximum apple crop. On the other hand, we are all familiar with the many experiment reports showing the great value of fertilizer. Each farmer should conduct an experiment station for himself to determine what best meets his needs for the greatest efficiency for the least expense.

Efficient irrigation of orchards is a matter that has been given very little attention. The farmer should know between what limits of moisture content his particular soil is best adapted to plant growth (for soils vary greatly in this respect). Record of the amount of water used should be kept, and the attempt made to definitely correlate that to the results.

The work which the National Orange Company of Riverside and the Limoneira Company of Santa Paula, and some others, are doing in actual performance records of individual trees is interesting and highly profitable. Both of these companies are making resets this spring as the result of their records. In course of time such records will be the source of removing the undesirable type of trees from their orchards and nurseries, and the establishment of distinct strains of high-grade trees

In pest control the same advantage of record-keeping holds true. In the case of an established pest, such as black scale, the question comes up continually, Will it pay to fumigate this season or wait until next, and only a record of the difference in yield and quality as over against the interest on the cost price can answer—usually the answer is in favor of fumigation.

In Ventura County the grower is faced by the question, Does it pay to spray for wither tip? The Limoneira people feel that through the record of their check plots, it does; but only through records can they be at all sure. The same holds true in regard to frost protection—what does it actually cost to smudge, including interest on investment and all? What has been lost in former years without smudging, and how do the two amounts compare?

The point is just this, that throughout modern agriculture it is essential to know definitely what each grove or crop is costing and returning. More than that, it is just as essential to know how that cost is divided, and where it can be reduced without injury, or where the ratio in favor of returns may be increased. Just as the National Post Office Department has cleared off its deficit through modern business methods, and as the California State Printing Office is improving its systems, so should each individual farm apply scientific rules of record-keeping to increase the general efficiency of the work done and money expended.

QUARANTINE IN SOUTHERN CALIFORNIA.

By Frederick Maskew.

The itemized report of the quarantine division of southern California for the month of January shows an increase in volume in the horticultural imports entering Los Angeles County of at least one third as compared with that of the month of December. A total of 4,869 packages were intercepted and passed upon during the month. A. S. Hoyt, inspector at San Diego, sends in a report which shows quite a material increase in the imports at that point also. His total for the month of January records 1,385 packages, of which it was found necessary to destroy 33.

A great majority of the foregoing was largely a matter of routine work devoid of any unusual developments. A new feature of this quarantine work, which the writer considers of much interest and value, is the reports now being sent in by the quarantine guardians. There is no question but what these inspectors have been faithfully and diligently doing this work in the past, but those with whom the present Deputy Quarantine Officer has come into personal contact are now recording their work in this line in a systematic manner, and thus making it possible to trace up the findings on each package. This is progress toward that much desired end—unity of purpose—the working together on the part of every official intrusted with the protection of the allied interests of the agricultural and horticultural industries of California. One of

the prime functions of the chief officer of every division should be to stimulate—if necessary create—this spirit of emulation among his deputies, and with the end in view of showing that these services are recognized and appreciated. I have brought together (perhaps for the first time) and incorporated in a supplementary report, which will eventually become a part of the horticultural history of the State, the special work of these county inspectors.

By far the most important item in the month's work was the finding by Inspector C. H. Vary of a fine, healthy colony of *Aleyrodes citri* on a jasmine plant from North Carolina. This was found in one of four large cases of ornamental trees comprising a shipment from the Biltmore Nurseries, Biltmore, N. C. Each of these packages had attached to it the orthodox form of certificate of inspection, signed in the usual manner of these Eastern certificates by a scientific entomologist. The foliage of this plant also showed many empty pupa cases from which adult *white flies* had emerged. The package containing these jasmine plants, together with its entire contents, were burned in the public incinerator by us at the expense of the owner.

This shipment of ornamentals was destined for the decoration of a superb estate in one of the immediate suburbs where citrus groves abound. It is useless to conjecture what expense, what anxiety, perhaps quarantine, might have eventually resulted had these infested plants passed undetected. In the opinion of the writer, basing his judgment on the wide experience gained by taking an active part in the white-fly campaigns of northern and central California, this catch alone justified the entire expense of the quarantine division of southern California for the present importing season.

A SERIOUS CHICKEN PEST.

(*Argas miniatus* Koch).

By E. K. Carnes.

Numerous specimens of this tick have been sent to the State Insectary for identification by county commissioners and poultry raisers.

As anything that in any way resembles an insect is referred to the county commissioners for identification, this article is offered with a view of enabling them to identify this tick, as well as our growers, most of whom keep some chickens.

Owing to the fact that the specimens have never been taken directly on fowls, and only in the coops, many poultrymen, being unfamiliar with the habits of the tick in question, do not realize the seriousness of the presence of this pest in connection with the raising of poultry.

The weakened condition of the fowls, as well as the mortality of the flock, is often laid to various other causes when in reality this tick is solely responsible for existing conditions. The peculiar feeding habits of the tick enable it, in a majority of cases, to escape detection for a considerable period.

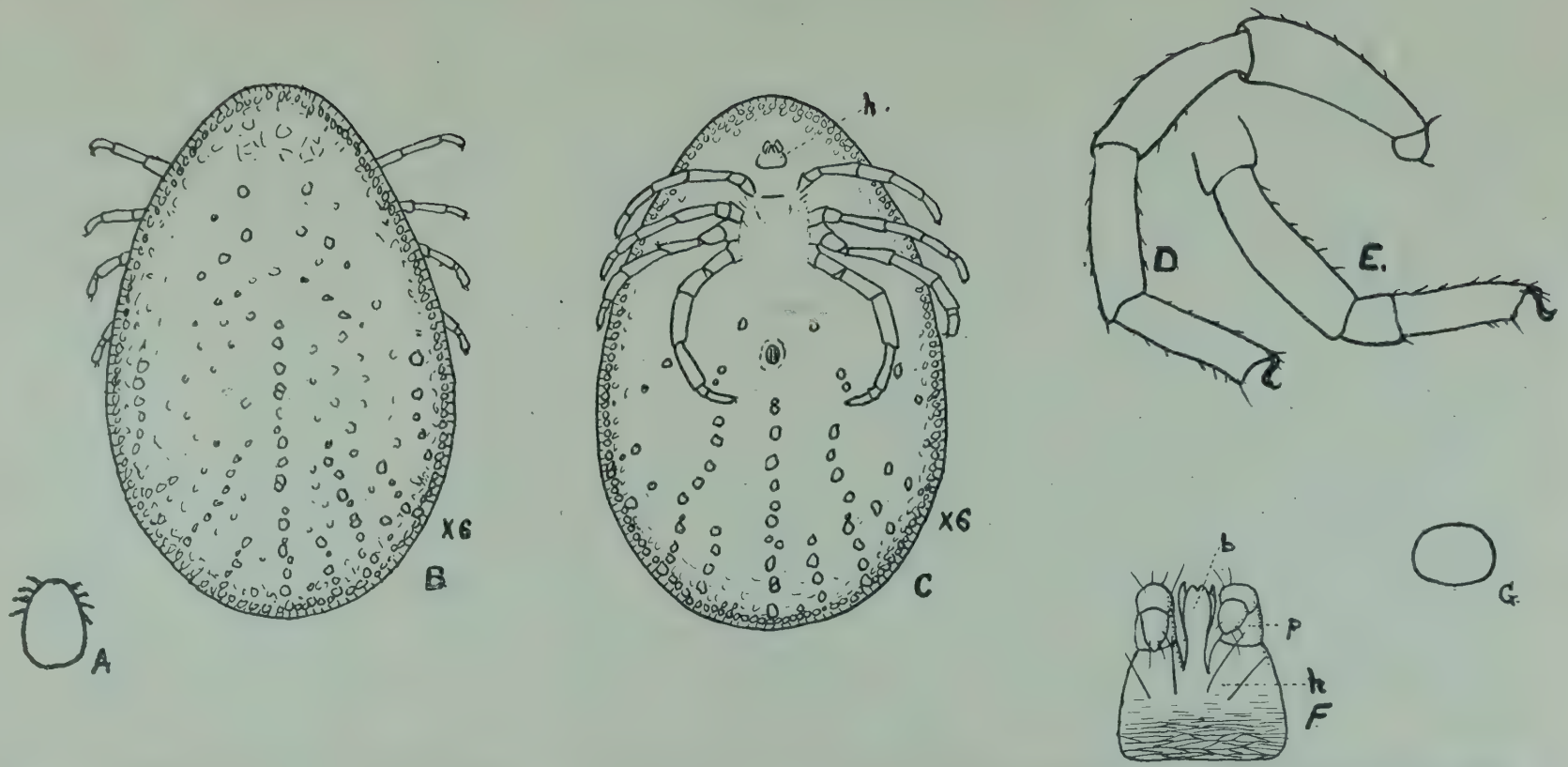

FIG. 46.—Chicken Tick (*Argas miniatus* Koch). A, Natural size; B, Dorsal view (much enlarged); C, Ventral view (much enlarged); D and E, Leg (after Banks. Enlarged); F, Head and mouth (enlarged); b, beak; h, head; p, palpus; G, Egg (enlarged). (Drawn by E. J. Newcomer).

Description.

Argas miniatus Koch (Fig. 46). Dark red-brown, legs pale yellowish, body nearly twice as long as broad, broader behind than in front, broadest behind the middle, tapering, and almost pointed in front, the margin often slightly upturned, except behind; surface densely and irregularly scarred and pitted, the smooth scars of varying sizes and more numerous on sides and behind, in latter part arranged somewhat in rows, a median row and two or more lateral less distinct; ventral surface scarred as above, most densely around the sides; palpi very short and lacking more than their length from reaching the anterior border; on rostrum at base of palpi is a transverse row of four bristles; the stigmal plate, which is scarcely distinct from the surrounding tissue, is a raised spot above the coxa, and with a curved anterior rim. Legs rather slender, tarsi barely longer than preceding joints, and suddenly narrowed at tip; the legs have very few hairs; coxæ are contiguous and radiate; front coxæ are distinctly separate from the others, and at the sides of the beak.

The male differs but little from the female; it is usually smaller; the male genital pore is not nearly as broad as the vulva, and is situated farther back, and behind it is a short curved groove each side. Length of swollen female half inch by one third inch. This species is a common enemy of poultry in the Southwest, from southern Texas to California. It occurs, also, on other animals, some times on cattle. This tick was first reported from Merced County, in 1894. Later reports from the vicinity of Sacramento and San Joaquin counties, show the presence of the pest in alarming numbers, and causing serious damage to fowls.

The surprising rapidity with which the pest may spread when once established and the many possible ways in which it may be spread, should cause all poultry keepers to assist in preventing further spread. In order to intelligently control the pest, it is necessary to know something of its curious habits.

The Eggs (Fig. 46, G).

The eggs are deposited in clusters of 50 to 100 in cracks or crevices, pink in color; easily seen with the naked eye, and hatch in about a month.

Larvae.

Very minute when first hatched, resembling somewhat ordinary mites, but possessing six very long legs, and when plentiful they cluster first under the wings of the fowls attacked, and have their heads buried in the flesh. After a few days feeding they drop off moult, and assume the form of the adult tick.

Feed at Night.

The ticks hide during the day and crawl on to the fowls only at night, and draw blood from them, and before daylight are back in the crevices hiding. They can live absolutely without food for at least a year, and an infested coop that has been unoccupied for a year can again infest a flock.

Immune Fowls.

The weakened condition of a flock, from no apparent cause whatever, may be directly traceable to the presence of this pest. The first indications are dull plumage, leg weakness, diarrhœa, which often results in death. Fowls that do recover from the attack appear to have become somewhat immune, probably due to inoculation by the poison, but requiring extra nourishment to offset the loss of blood.

Trees become infested by means of fowls carrying the young larvæ into trees before the moult and the young tick secretes itself under the bark.

An exchange of shipping crates is often responsible for an infection. New stock added to a flock; even a single fowl has been known to carry infection to an entire poultry yard, during the larval period of the tick, which does not exceed a week, during which time it remains on the fowls all the time.

Eradication.

This is best accomplished in the coops and houses, and in Sacramento County the most successful, and, in the long run, the cheapest way has been by burning the old coops and replacing them with new ones, fitted with tick-proof roosts, suspended by wires, or oil-pans connecting the roost with the frame of the building.

Fumigation has been successfully used as a means of control, and many sprays, oils, etc., are useful. Boiling water, kerosene and tar are also useful in control measures. Separate coops, kept free from fences and other buildings, are the best to use where the pest is present and control is attempted.

GENERAL NOTES.

POTATO SCAB.

Since assuming the duties of State Commissioner of Horticulture, I have received more inquiries regarding "potato scab" than any other single plant disease. Most of these come from county horticultural commissioners or inspectors. This disease of potatoes, caused by a fungus (*Oospora scabies*), is certainly very common and widespread throughout the State. The ugly, roughened appearance of the tubers is not easily mistaken, and is too well known to need description.

As this is a fungoid ailment, its presence may come from planting scabby tubers or planting in a soil which has before produced scabby potatoes. The germs must be present or there would be no scab. Of course stable fertilizer may carry the fungus if scabby potatoes have been added to it; and the use of plows or harrows previously used to cultivate soil, where scab was present, might result in inoculating the soil.

If soil is infected, other crops than potatoes or root crops should be grown for three or four years to rid it of the disease. If we use a virgin soil, we should take all possible pains to keep the fungus from entering it. It is found that alkaline soils (California soils are mainly alkaline) and strong, damp heavy soils are peculiarly favorable to the development of the potato scab fungus.

As this affection is existent in nearly if not quite all our potato sections, we can hardly refuse to accept such potatoes, but we should never use them to plant unless we first treat them to destroy the germs, and never then if it is possible to secure others for planting.

The treatment is to place the affected tubers either in a solution of corrosive sublimate or in weak formaldehyde (formalin). We must remember that the former is a virulent poison. The second is made ready as follows:

Formalin, one half pint, is added to 15 gallons of water, stirred thoroughly, and the whole potatoes (not cut) are immersed in this for two hours. This kills the spores, and usually insures sound potatoes, unless the ground is infected.

The corrosive sublimate solution is prepared in either an earthen or wooden vessel, as the liquid corrodes metal. We dissolve two ounces of the chemical in two gallons of hot water, then add enough cold water to make 15 gallons. The uncut tubers are placed in a sack and immersed in the liquid for one and one half hours. Either of these germicides may be used over and over, adding fresh liquid as needed.

As this trouble is so general in the State, unless one knows his county to be free of the fungus, a quarantine against scabby potatoes would be unjust and unwise. The disease is so repulsive in its disfiguring effect on the tubers that if it had not been so generally introduced, we would be justified in taking drastic measures to keep it from entering any clean

section of the State, infecting our soils and injuring one of our most important crops.

In buying potatoes, one would certainly never purchase those affected with scab unless he could get no other, and surely would not plant them unless he treat them thoroughly as directed above.—A. J. Cook.

QUARANTINE WORK AT SAN DIEGO.

The quarantine division of the State Commission of Horticulture, represented in San Diego by the writer, meets, on the average, twenty-four ships a month from the ports of Mexico alone. The average number of packages on these boats containing articles to be inspected is seventy-five. Over half of these are composed of beet seed from Germany, shipped through Mexico by the Tehuantepec route. The remainder consists of plants and fruits, and because of infestation by injurious insects, about thirty-five are destroyed every month.

The plants have been found infested with red, purple and black scales and borers. The fruits, principally those known to be host fruits of the Mexican orange maggot, have not yet shown any indications of the presence of this pest. The citrus fruits have, without exception, been badly affected by red and purple scales and mealy bugs. Most of these packages are found by the customs inspectors in the baggage of the passengers. As many of the latter are tourists, it is at once apparent that the danger of infestation in the citrus-growing regions is imminent.

The reëstablishment of the quarantine on citrus fruits from Mexico is of the greatest assistance in handling importations at this port. Particularly is this true in the case of guavas and mangoes, as these fruits, unlike oranges and limes, are not usually infested with insects visible from the outside. Before the passage of the quarantine order, an orange infested with red or purple scale or mealy bug was destroyed, and since practically all were infested with one or all of these pests, a virtual quarantine was in operation. In the case of the guavas and mangoes, however, it was necessary to cut open the fruit in order to detect the presence of the maggot, and since this is the only pest attacking these fruits, a rigid quarantine is the only method by which safety is assured.—A. S. Hoyt.

POTATO EELWORM.

This worm has been very thoroughly discussed in the three numbers of the Monthly Bulletin already published. It is our aim, at this time, to add only new matter that has come to light since the issue of the articles in question. We now have positive evidence that this potato pest is in two counties of California, Inyo and Nevada. We have it also from two cars said to have come from Los Angeles County, one from Irwindale, billed to Sacramento, the other Sawtelle, shipped to Santa Ana. The improbability of potatoes raised in the south coming north makes the suggestion that the car from Irwindale may have been sent south from Nevada to escape detection and then reshipped to Sacramento.

We know now of a certainty that this potato eelworm is in our State, but as yet not generally, indeed, very rarely an enemy of the potato. One of the first delegations that came to this office to urge cessation of interference with the importation of infected potatoes from Nevada into California, were very insistent that Nevada potatoes were never planted in California and were never a success when planted. The eelworm potatoes from Nevada County, California, are known to have been produced from seed imported from Nevada. I think there is no doubt but that Nevada seed potatoes would grow as well in California soil as anywhere. This example from the county of Nevada proves that this is not mere theory.

I think that, as yet, most of our potato sections of California are unmolested by the potato eelworm. The nematode if present in the soil has not yet acquired a taste for our potatoes. When I came to California, I had no liking for olives; now this nutritious fruit disappears surprisingly quick from our table.

In the two counties where we know this pest to be present, Nevada and Inyo, they are in isolated valleys and the county commissioners of those counties are keenly alive to the necessity of the situation and will commence at once the process of eradication, and restriction of the infestation to the present limited areas. They have a superb opportunity to practice the most approved methods and I hope and trust will confer a great blessing upon other sections of the State by the results of their efforts. This office will co-operate with them, without stint, to this end.

The rough, mammalated appearance of tubers that are infected, the lesion of the flesh of the potato just beneath the peel and the female worm which can be discovered by the unaided vision, make it easy to detect eelworm attack. There are two things that all must do: Investigate thoroughly to find out any region of infestation. If it is elsewhere in California we must know it and the locality. It is also incumbent upon us to make every effort to keep it out of our soil. No eelworm potatoes should be imported into uninfested territory, lest the peel or infested portions of the tubers be thrown where they will permit the escape of the worms into the soil; and surely no affected tubers must on any account be planted.

The experience in the county of Nevada, and I presume Inyo as well, should come as a serious warning to all. As yet the infestations are in secluded valleys and we may hope that they will spread no further, and will soon cease to exist. It is not, however, a quick matter to subdue these lower animals. They have a hold on life ofttimes that is truly remarkable. It is said that actual demonstration has shown that these potato eelworms have lived without food for eight years. We can but hope that this is an error.

Let me urge again, if the eelworm is absent from any locality in California where potatoes are grown, make every effort to keep it out; if it be found to be in any locality, for our own well-being, and the good of others in the State, make most careful inspection to ascertain this fact.—A. J. Cook.

SERIOUSNESS OF THE MEDITERRANEAN FRUIT FLY.

Since the alarm was first sounded with reference to the great danger there was of the Mediterranean fruit fly, *Ceratitis capitata*, finding its way into this State, and the damage it would cause to the fruit industry of this state, I, as well as the others who have been doing all in our power to prevent its introduction, have been accused by some people of being alarmists, and that the discussion of the subject of keeping the fly out of the State will have a tendency to frighten some people and prevent their buying land for planting to fruit, and also tend to keep eastern buyers away. Some have set up the argument that the presence of the fly in Australia has not caused any depreciation of land values there.

In answer to such arguments I will say that it is quite correct that the land values in Australia have not suffered in the least by the presence of the fruit fly there. The industry of Australia is wool and stock, and if not a single fruit was produced in that country it would not reduce the value of her land. The same with the Hawaiian Islands; if they never produce another fruit on those islands their land values will remain the same, for there the industry is sugar, which the fly does not bother.

The industry in California is fruit, and let the fly get in and destroy from seventy to ninety per cent of our fruit each year, what will be the results?—Geo. Compere.

PEAR BLIGHT.

The pear blight, if the name had not been previously used might well be called "quick consumption." It is a bacterial disease caused by the presence of millions of very minute bacteria, known as *Micrococcus amilovorus*. Its virulence and quick action are always surprising. The germs are in the liquid of the trees; sap, gum, and nectar, and are usually spread by bees or other sweet-loving insects; being carried as they sip sap, nectar, or by bees as they gather bee-glue (*propolis*.) This explains the rapid spread of this malady at the time when the trees are in bloom. In gathering sap or gum from wounds of the trees, insects infect nursery stock. The blackened, constricted bark, the discolored wood, in twig, branch, trunk or root, and the prematurely reddening of the autumn foliage, is the quick, sure tell-tale that this disease is present. The sweeping off of old orchards in quick time has made this disease one of the most dreaded in the realm of plant maladies. The disease varies in activity and virulence with the character of the season; an early, wet season is supposed to be conducive to its rapid development.

Mr. E. A. Gammons' successful experience proves (see Monthly Bulletin, Vol. 1, No. 2) that this scourge can be mastered, at an enormous profit, though it cost money to do it. This is also a vivid illustration that thoroughness pays big money. The remedy consists in cutting out

every cut of diseased tissue, even deep down in the root system, and a very thorough disinfecting of chisel or other tool after each time it is used.

I have many inquiries regarding the policy and duty of the county commissioner in respect to this pestiferous pear blight.

If the disease is not in one's county, then no stock for planting should be permitted to come from a region where the disease is present. Several counties of our State have no pear blight so far as I have observed. To secure young trees from a county where this disease is found would be in such cases the extreme of unwisdom. In no case

FIG. 47.—Pear blight bacteria. Highly magnified. (U. S. Dept. Agrcl.)

should trees showing the least sign of the disease be sent out from any nursery or accepted by a county commissioner. In case some trees of a shipment show affection and others not, only the diseased trees could be rejected, unless a county ordinance made it legal to refuse all in case any trees were diseased. The same ordinance could also quarantine against all pear stock from a region where the disease existed. It would seem wise to have uniform laws throughout the State. Thus, a well digested, carefully formed state law, covering all such cases, could wisely replace the several county laws now on our statute books. Nurserymen, fruitmen, all of us, are interested in the enactment of such a law, and we may reasonably hope that before the next legislature convenes one will be formed that will safeguard the interests of our fruit growers and at the same time work no harm to any one.—A. J. COOK.

NOTES FROM THE COUNTY COMMISSIONERS.

By G. E. Merrill.

Contra Costa County.

A general spraying campaign has been prosecuted by the orchardists against the various lecaniums, mosses and lichens on the trees. The crude oil emulsion was the formula most generally used. Mr. Anderson of Walnut Creek has used over 2,100 gallons of crude oil so far this spring in his spraying operations.

Humboldt County.

Mr. Geo. Weatherby has recently been appointed county horticultural commissioner. Mr. Weatherby has named A. D. Roberts as his first inspector.

Los Angeles County.

The ranks of the county horticultural commissionership have been visited by the Great Destroyer for the first time through the death of A. R. Meserve.

Nevada County.

County Horticultural Commissioner Mr. Linden Bree recently conducted a pruning demonstration in his district.

Sacramento County.

At this writing the pear thrips are beginning to make their appearance at Courtland and vicinity. Very extensive preparations are being made for this season's tilt with the pest.

Santa Clara County.

Mr. Morris reports an outbreak of *Diabrotica sorer* on young alfalfa. The damage is done by the adult form of the insect. The pest works by devouring the two seed leaves just as they emerge from the ground, thus killing the plant. So far about forty acres are known to be affected.

Solano County.

The pear thrips are appearing in numbers at this writing, and general preparations are under way to give them a warm reception.

Sutter County.

The board of supervisors has recently passed an ordinance quarantining Sutter County against stone fruit nursery stock from districts where the western peach borer is now known to exist.

Tulare County.

Mr. J. R. Horton, agent and expert of the United States Department of Agriculture, reports that he is planning to do his customary demonstration work against the orange thrips during the coming season.

Commissionership Examinations.

Examinations for the post of County Horticultural Commissioner will be held in Los Angeles County on March 23d, and in Inyo County on March 20th.

Requests for the holding of examinations in San Luis Obispo, Modoc, San Francisco and San Mateo counties have already been received.

GUM DISEASES IN CITRUS TREES.

By H. S. Fawcett.

An Attempt to Outline in Brief Form the Present Status of Our Knowledge of Gum Diseases of Citrus Trees as occurring in California and Florida.

Considerable confusion and misunderstanding is likely to arise in regard to gum diseases of citrus trees and their treatment because:

First—There are at least six entirely different and distinct troubles

Fig. 49.—Gummosis of lemon. (California Experiment Station.)

in which gum oozes out from the trunk or larger limbs of citrus trees; and because,

Second—Some of these troubles have come to be known by growers and others under one name in California and under an entirely different name in Florida (the same name in at least one case, scaly bark, having been used unfortunately, for different troubles in the two places); and because,

Third—Some forms of gumming appear to be common in one place, and are very rare or not found at all in the other.

In writing on such a general and indefinite subject as gum disease, therefore, it is not to be wondered at, that one writer may have in mind one trouble and another an entirely different one.

It is the purpose of this article to attempt to distinguish between the different forms of gumming occurring in California and Florida using first the common names adopted in California under each heading, and giving afterwards other names that have been used in other places, and to give briefly what is known as to the causes and remedies for them.

GUMMOSIS OR LEMON GUM DISEASE.

The word gummosis has been adopted in California for the most common and destructive form of gumming on the trunk of lemon trees. Gum pushes out through cracks in the bark, almost always above the union of the stock and scion. It does not affect the tree at the roots nor high up in the branches. The bark in this trouble does not usually scale off or flake off. (Fig. 49.) This trouble appears to be almost always associated with unfavorable soil and drainage conditions.

Professor R. E. Smith in Bulletin No. 218 of the California Station, says of gummosis: "It occurs on poorly drained, heavy soil, especially if the point of budding is deeply covered with earth and where the soil about the trunk is undisturbed by cultivation."

It is obvious, therefore, that it is easier to prevent gummosis, than to cure it after it has begun. Ralph E. Smith and O. Butler, in Bulletin No. 200 of the California Experiment Station, describe in detail methods both of prevention and treatment. The preventive measures given are—

1. The avoidance of unfavorable soil conditions.
2. The use of sour orange roots.
3. High budding.
4. Proper irrigation, drainage and cultivation.

The methods given for treatment of gummosis after it has started are briefly:

1. Improvement of soil conditions, such as drainage, better irrigation methods, and loosening the hard soil about the trunk.
2. Slitting the bark and treating the slits with neatsfoot oil.
3. Pruning back.
4. Placing sand about the trunk.
5. Boxing.

Judge A. F. Call in the proceedings of the Thirty-seventh Fruit Growers' Convention held at Pomona, September, 1910, tells of successful treatment of this disease by methods corresponding to those given in the

FIG. 50.—California scaly bark or psorosis on orange. (Photographed from a California specimen sent to the author in Florida.)

above mentioned Bulletin, and many other growers have reported success with practically the same treatment.

SCALY BARK OF CALIFORNIA.

This disease has been known as Psorosis and "Gumming" in Florida. It was also at one time considered by the writer to be a stage of Diplodia Gumming, but is now thought to be distinct. It is sometimes confused with, but is not the same as the disease described as Scaly Bark or "Nail-Head Rust" in Bulletin No. 106 of the Florida Experiment Station.

FIG. 51.—California scaly bark or psorosis showing gumming on orange branch. (Photo by O. F. Burger, Fla. Exp. Sta.)

The unfortunate use of the same name for two distinct troubles seems to have come about because the names were suggested by a certain scaling and flaking of the bark that is common to the two diseases.

Scaly bark of California is usually confined to the orange trees. It is characterized by the bark being pushed up and broken into pieces over areas two inches or less to a foot or more in length. The patches assume a shaggy, ulcerated appearance (Figs. 48 and 50). They may extend entirely around the trunk or large limb or may be confined to one side. The drops of gum which accompany it (Fig. 51) exude most during the growing period and usually cease to form on the exterior in the fall and winter.

The cause or causes of California scaly bark and the factors influencing its occurrence appear to be as yet rather obscure. R. E. Smith and O. Butler in Bulletin No. 200 of the California Station after mentioning its obscure nature say: "It would seem that scaly bark is connected more than any other condition with one of extreme changes in moisture conditions of the soil, and that a large majority of the present cases of disease, affecting isolated scattered trees in groves where no unfavorable conditions can be detected, are relics of a former period of cultural or irrigation practice different from that now in vogue."

The treatment given by R. E. Smith, in Bulletin No. 218 of the California Experiment Station, is briefly as follows:

1. The worst affected trees should be dug out and replaced.

2. When only affecting certain branches these should be cut out.

3. Small areas on the trunk should be cut out to healthy bark, and the wound treated.

4. Any hard soil about the trunk should be dug up.

FOOT ROT OR MAL DI GOMMA.

This trouble should not be confused with "root rot," which is a very different disease, (see article by Prof. W. T. Horne on Root Rot).* Foot rot is very common in Florida, especially on old seedling trees, but appears to be of rare occurrence in California. Gum exudes on the trunk of the tree just above the soil. The inner bark and finally the wood underneath becomes rotten and often has a very disagreeable, fetid odor. The bark dies and breaks away in patches leaving bare, dead areas which spread in all directions, mostly down on the main crown roots and laterally around the trunk. Trees affected bear heavily and the leaves become yellow. It is distinguished from the root rot by the absence of the black strands and fan-like mycelia that are found on the roots of root rot specimens. "Foot rot," as the name suggests, is more confined to the foot of the tree, and does not, in its first stages at least, rot the roots out to the end as does the root rot.

An Italian scientist, G. Briosi, in 1878 found a fungus (*Fusarium lemoni*) constantly associated with the disease, and was inclined to consider it responsible for the rotting of the bark and wood. Foot rot appears to be contagious and great care should be used to disinfect instruments that have been employed in cleaning out diseased trees. The following conditions appear to favor its development in Florida, although cases may be found under all conditions: Improper drainage, too close planting, continuous excessive irrigation, deep planting. Fortunately, foot rot may be perfectly prevented by budding nursery trees to sour orange roots. This has been done for many years in Florida and has controlled the disease perfectly, even where the sour orange roots were used as resets in badly infested orchards. Professor Hume says in Bulletin 53, Florida Experiment Station—in order of foot rot resistance different citrus stocks stand about as follows: (1) sour oranges; (2) pomelo; (3) rough lemon; (4) lemon; (5) sweet orange. (1), (2), and (3) may be roughly classed as decidedly resistant; (4) and (5) as much subject to the disease.

Many foot rot trees have been cured in Florida by digging away the earth and exposing and drying out the crown roots, cutting away and cleaning out the decayed areas and disinfecting them. A number of good disinfectants have been used with about equal success. Some of these are crude carbolic acid and water 1 to 3 parts, sulphurous acid and water 1 to 6 parts, avenarius carbolineum one gallon to one gallon of water in which one pound of whale-oil soap has been dissolved, or strong, thick Bordeaux mixture applied like whitewash. Cleaning out and drying out the crown roots seem to be more important than the disinfecting.

*Thirty-seventh annual report of the Fruit Growers' Convention, State Commission of Horticulture, Sacramento.

ROOT ROT.

More or less gumming also accompanies the root rot or oak fungus disease due to *Armillaria mellea*. This gum oozes out at or just above the base of citrus trees, and might be confused with that due to foot rot. Root rot is characterized by a rotting of the roots out to the ends, and of the bark and wood at the base of the tree with black strands on the roots and fan-shaped, felted, white growths crowding into the live bark. It is accompanied only by a clean mushroom odor, and by the development of certain toadstools near the base of the tree in the fall and winter.

As this disease is to be so well described and beautifully illustrated by Prof. W. T. Horne in an article in the next number, it is only necessary to refer to that article, when it appears, for the details in regard to this trouble.

DIPLODIA GUMMING.

This form of gumming, or the fungus causing it, is not known to exist in California. In Florida with this form of gumming the writer found in the discolored bark inner and wood, a certain fungus present. When this fungus was isolated in pure cultures and inserted into cuts in the bark of healthy trees a copious flow of gum with killing of inner bark and wood tissue always resulted.

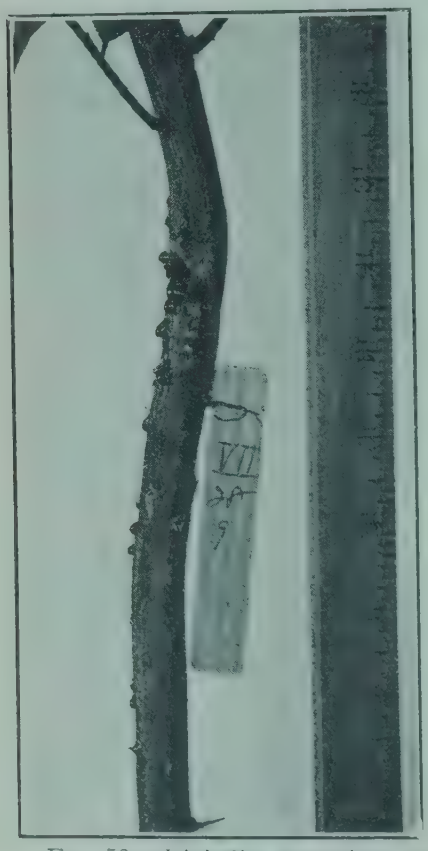

FIG. 52.—Diplodia gumming on young orange tree after inoculation with a bit of fungus. (Photo by O. F. Burger and author, Fla. Exp. Sta.)

This form of gumming is characterized by gum oozing out through cracks in the bark, usually on branches. In severe cases on larger limbs, areas of bark die and the wood is blackened. The discoloration of the wood often extends along the limbs much beyond any external sign on the bark. When smaller branches are affected they are often killed back to some distance and numerous black spore cases push up through the bark.

This kind of gumming was induced in more than 25 different inoculations, covering a period of over one year (Fig. 52). That cutting into the bark in itself was not the cause of the gumming was proved beyond question, by making with every different set of inoculations the same kind of cuts without the insertion of the fungus. Such cuts protected from contamination always healed up without gumming. The fungus placed on the uncut or uninjured surface of branches or

twigs, however, did not infect them except when the growth was very soft and tender. Pomelo trees in Florida appeared to be most susceptible to its attack. The fungus probably enters through injuries or wounds. Cutting out the worst diseased limbs, or cutting out the area as they begin to form on one side of the larger limbs, or cutting out smaller branches entirely, were the methods used in controlling this trouble in Florida.

This same fungus was isolated from at least twenty-five different specimens from six different counties of Florida. This fungus, scientifically known as *Diplodia natalensis*, was first described in South Africa in 1910 by I. B. Pole Evans in connection with a serious rotting of lemons and other citrus fruits.

In Florida, the writer also found this fungus to be causing serious rotting of all kinds of citrus fruits (especially when slightly injured) in addition to the gumming of larger limbs or smaller branches. It was also found by be the cause of a gumming of peach trees in Florida, by O. F. Burger* (Fig. 53). The seriousness of the disease makes it highly important that it be kept out of California.

FIG. 53. Diplodia gumming on a young peach tree after inoculation with a bit of the fungus. (Photo by O. F. Burger, Fla. Exp. Sta.)

FLORIDA SCALY BARK OR "NAIL-HEAD RUST."

The disease is entirely distinct from the California scaly bark which is treated of under a previous heading. It, as well as the Diplodia gumming, is not known to exist in California. It is also a very destructive disease, because in its severe stages it not only covers the tree with ruptured bark from the trunk to the smallest branches and twigs, but also spots the fruit and causes them to drop just before maturity. It is extremely important therefore that neither of these last two

*Fawcett, H. S., and Burger, O. F.—A gum inducing diplodia of peach and citrus, Mycologia III, 151-153, 1911.

diseases be allowed in any way to get into this State. The disease is fully described and illustrated in Bulletin No. 106 of the Florida Experiment Station, Gainesville. It is known in Florida and distinguished from the California scaly bark by the following characteristics:

1. On the smooth bark of branches 6 to 9 months old and older will be found more or less round or oval spots one sixth to one half inch broad, raised above the surface, rusty in color, with well-marked edges. As the spots grow older the bark becomes glazed, then brittle, shows cracks running lengthways, and at last breaks into small flakes and scales. In severe cases, these spots increase in number till they join together, forming large patches of rusty or reddish-brown scaly and scabby bark, accompanied by small drops of gum.

2. On the larger limbs, and sometimes on the trunk, will be seen patches of rough scaly bark, the small pieces of which shell off as the hand is passed over them. In this stage it is hard to distinguish it from the Psorosis or California scaly bark. (In some cases this scaliness of the old bark may be absent.)

3. On the fruit will usually be found brown sunken spots, some of which are apt to be in the form of sunken rings. These spots are at first yellowish to reddish brown on the green fruit, and finally become dark and sunken. In ringed spots the rings first become sunken with a higher part inside. This central part afterwards sinks in, and the whole area inside the ring becomes dark. The spots vary in breadth from one fifth to one half inch.

The initial spots on small branches have been produced by the writer in Florida by inoculation with a fungus known as *Cladosporium herbarum* var. *citricolum*. There seemed to be other factors that entered into the cause for the later stages in the development of the diseased areas. A second fungus, *Colletotrichum gloeosporioides*, appeared to be one of the main secondary factors in the destructiveness of the disease.

Since the disease is not known in this State it is unnecessary here to give methods of treatment. If any one finds anything suspiciously like this description, the writer would be glad to receive specimens for identification.

GUMMING FOLLOWING INJURIES.

Gumming has been noticed to follow certain injuries to a citrus tree, such as pounding it with a hammer, or knocking off the bark at the base with tools used in cultivation, bolting, driving nails, and sometimes even in the operations of budding and grafting. Whether the gum formation in a majority of such cases is due to the injury alone, or is induced in part through the influence of some other factor or factors such as organisms or impurities from the air or bark that get in as the result of the wounds, seems to the writer an open question needing further study.

The application to the bark or to cuts of certain chemicals has also been shown to be followed by gumming. Gum has been noticed as an

almost inevitable accompaniment in Florida of placing a crystal of copper sulphate under the bark. O. Butler* reported gumming to follow the application to the bark of sulphuric, phosphoric, nitric and lactic acids.

Besides these, there are a number of other milder forms of gumming which take place out on the twigs, or on the fruit. These need only be mentioned here as they usually cause only a slight amount of gum.

Exanthema or Florida dieback on twigs and fruit.

Cottony fungus on twigs (in California).

Wither-tip fungus on twigs (very slight).

Stem end rot fungus (in Florida) on twigs.

To sum up the troubles of citrus trees in which more or less gum issues from the trunk or large limbs, we have—

1. **Gummosis, or lemon gum disease,** mostly on lemons, characterized by an oozing of gum from cracks in the bark usually just above the union of the bud and scion, without scaliness of the bark.

2. **Scaly bark of California,** which equals Psorosis of Florida—mostly on oranges, occasionally on grapefruit. Characterized by patches of scaly, shaggy bark with gum drops at their edges and with gum-filled outer wood and the formation of new bark under the old, making an uncerated cankerous appearance on the trunk or larger limbs.

3. **Foot rot or Mal di gomma,** common in Florida (rather rare in California) mostly on sweet seedlings, also on lemons, characterized by gumming and rotting (with a disagreeable fetid odor) of patches of bark and wood at or near the base of the tree.

4. **Root rot,** characterized by a rotting of the roots, and the bark and wood, at the base of the tree, with black strands or rhizomorphs on the roots and fan-shaped felted white growths crowding into the live bark, accompanied only by a clean mushroom odor (not putrid as in case of the foot rot).

5. **Diplodia gumming,** in Florida, on all varieties of citrus and also on peach, characterized by gum oozing out of branches of all sizes, by a killing of the bark, a blackening of the wood and at times by the formation of black spore cases on the bark.

6. **Florida scaly bark, or nail-head rust** (not known in California), mostly on sweet orange trees and fruits, characterized by small rusty glazed, oval, well defined spots on the smooth newer growth followed by a scaly or scabby surface on the older bark as the branches enlarge, and by reddish brown, hard, sunken spots on immature oranges on the tree, often in the form of rings.

The literature considered by the writer to be the most useful to citrus growers, on the six forms of gumming herein mentioned are—

Bulletins No. 200 and No. 218 by California Experiment Station, Berkeley, Cal.

Bulletin No. 8 of the Division of Vegetable Physiology and Pathology (probably out of print), U. S. Department of Agriculture, Washington, D. C.

*Gummosis of Prunus and Citrus. Annals of Bot. XXV, p. 130, 1911.

Citrus Fruits and Their Culture, a book by Prof. H. H. Hume. Geo. S. Marys, Fla.

Proceedings of the Thirty-seventh Annual Fruit Growers' Convention. State Commission of Horticulture, Sacramento, Cal.

Bulletin No. 106, Fla. Agric. Expr. Station, Gainesville, Fla.

Proceedings of Fla. State Hort. Society for 1911. E. O. Painter, Sec'y. Jacksonville, Fla.

THE FRUIT FLY MENACE AND PREVENTIVE MEASURES.

By H. A. Weinland.

Undoubtedly the most of the readers of this bulletin are more or less familiar with the subject of the Fruit Fly menace, which in the form of the Morelos Orange Maggot (*Anastrepha* (*Trypeta*) *ludens*), from Mexico, and the Fruit and Melon Flies (*Ceratitis capitata* and *Dacus cucurbitæ*) from the Hawaiian Islands, seriously menace California's fruit growing interests.

Whether these pests can always be kept from becoming established in the State is a question no one can answer, but it is certain that all three are on the threshold and may enter at any time in spite of all that is done. The present status of each of these and the means used to prevent their entrance should be of interest. I will discuss only the two latter — the Fruit Fly (*Ceratitis capitata*), and the Melon Fly (*Dacus cucurbitæ*).

The melon fly has been a pest on the Hawaiian Islands for as many as twenty-five years, and has become established on all the islands of the group. It is particularly destructive to melons and certain vegetables. On March 28, 1910, Quarantine Order No. 4 was issued, barring from the State watermelons, muskmelons, cucumbers, and tomatoes from these islands or from any other place in which this fly is known to exist.

The fruit fly was first reported from the islands in October, 1910. It has spread till it is now on all but one of the group. On June 24, 1911, Quarantine Order No. 6 was issued, barring from California all vegetables and fruits excepting pineapples and bananas and all root crops. A list of the host fruits of the fly will show how cosmopolitan an insect it is in its habits. The Territorial Board of Agriculture and Forestry of Hawaii have bred it from—

Strawberry guava.
Peach.
Alligator pear.
Chinese orange.
Guava (garden varieties).
Green peppers.
Figs.
Rose apple.
Star apple.
Mountain apple.
Orange (varieties of sweet and sour).
Coffee berries.

Wild guavas.
Chinese plum (*Noronhia emarginata*).
Mango.
Limes (varieties).
Carissa arduina—a South African fruit.
Papaya (in ripe condition).
Kamani seeds (species).
Cestrum (Chinese ink berry).
Grapefruit.
Prickly pear (*Opuntia tuna*).
Loquat (*Eriobotrya japonica*).
Var. persimmon (1 introduced tree).
Carambola.
Kumquat (*Citrus japonica*).
Murraya exotica (small red fruit locally known as mock orange).
Eugenia (species).

In the summer of 1911, Superintendent Carnes of the State Insectary was dispatched to the islands to determine the condition of and to make recommendations regarding California's safety. His subsequent report appeared in the first issue of this bulletin.

In December, 1911, the new Commissioner (Dr. A. J. Cook), following previous recommendations, dispatched the writer to Honolulu to remain stationed at the above port as an inspector, for the purpose of determining by constant attention just where the dangers lay and to suggest means whereby they could be reduced or prevented.

I arrived here on the 26th of December, and after finding temporary quarters, met Mr. Ehrhorn, Superintendent of Entomology, and Mr. Giffard, Director of the Fruit Fly Control.

The territory had raised $8,750 a few months previously, and in November the clean culture campaign had been launched. It had been understood that California would appropriate an amount equal to this, to be used in this joint campaign, for the betterment of conditions in the islands, and for California's safety. I found that the territorial funds were made available continuously up to 1913, making it impossible for them to employ more than four inspectors at a time. The pressing need was for available money to increase the number of inspectors, and enlarge the quarantine district. I at once set about bringing together the two commissions on a mutual basis, and on February 1st, California began to meet a share in the expense of the campaign.

I have also attempted to analyze the avenues of danger to California. It is undoubtedly true that there exists a danger, as the fly has spread to all but one of the islands of the group in spite of all precautionary measures, and might in the same way reach California.

Under the geographical conditions, the fly can travel in no other way to California than by means of the ships. Also the three ways in which the ships might carry it are, in the cargo, in the stores, and by passengers.

By Quarantine Order No. 6, pineapples and bananas are the only fruits allowed to come to our coast as cargo. As was earlier reported, pineapples seem to be immune in all stages, but bananas, ripe and with the peel removed will support a life cycle under laboratory conditions. Careful and continuous investigations of ripe and bruised bananas in the markets and on the dumps failed to reveal any infestation whatever. Under these conditions we may have no fear, I think, from these fruits, shipped as they are in a very green condition.

I was not satisfied, however, with the method of marketing these bananas. There was no way to govern the conditions under which they were packed, handled, etc. I found that there had existed for a short time under the Division of Immigration and Labor a marketing division, organized for the purpose of helping the small farmer. I made an attempt to have this department take over the exporting of bananas. The new quarantine law, signed by the Governor in January, came to the rescue. By this law the quarantine officers could refuse landing to all scale-infested fruits and horticultural products, which meant that at least one third of the bananas previously shipped were barred. The market superintendent, Mr. Starret, then undertook the inspection and tagging of bananas, weeding out the scale-infested ones, and with the help of Mr. Ehrhorn and Dr. Wilcox of the United States Experiment Station a campaign for cleaning up the banana fields of scale was inaugurated, which promises well. One of the purposes of this campaign is to put the banana business on a safe basis. Consequently, orders have been issued to remove all split bananas from the bunches, to clean the fields of old scale-infested leaves and any other possible source of infection.

On March 1st Mr. Starret took entire control of the whole shipments, having received a commission as honorary inspector under the Board of Agriculture and Forestry. On the same date Mr. Bremner, Chief Quarantine Officer at San Francisco, arranged with the steamship companies that they should not take on any fruit or vegetables as cargo without the tag of this department.

As for ships' stores, after noticing the departure of some, I observed that certain vegetables were taken on which might have been hosts for the melon fly, and though it was the custom that whatever perishable stores were left from the trip should be destroyed 100 miles from San Francisco, it was thought wise to prevent even this danger. Consequently, on February 24th Mr. Ehrhorn and myself took up the matter with the steamship companies, resulting in their not receiving as stores from this port cucumbers, tomatoes, papayas, bell peppers, string beans, alligator pears, and mangoes. By interviewing Captain Game, harbor quartermaster here, and writing to the quartermaster general in Washington, the transports were put under the same orders. Each coastwise sailing vessel is visited by an inspector, its stores examined and watch kept for any fruit which might be carried to any port on the Pacific coast. The problem of the passengers also presented difficulties. An agree-

ment had been made in June, 1911, with the Matson Navigation Company and the Oceanic Steamship Company, whereby a contract was attached to each ticket in which the passenger agreed to the inspection of his baggage on arrival in San Francisco, and whereby a notice was to be handed to each passenger, making clear the details of the inspection. I found, however, that no more notices were to be had, the supply having given out, and only one company was using the contract, yet the authorities in San Francisco were examining as agreed. Supplies of this kind, however, are on the way and will soon be in use. The writer, together with one of the California paid inspectors, is at the gang plank of every outgoing passenger vessel to hold up any fruit that might be dangerous.

The greatest safety, however, in this line lies in the matter of keeping the markets clean. Passengers, stopping over, patronize these markets largely, and if there is no infested fruit to be bought, there will exist less danger from this quarter. An inspector visits the markets daily and all infected or suspicious fruit is destroyed and a full report made. The present condition of the markets can be seen in the fact that these reports show that in the last three weeks only three lots of fruit (figs) have been condemned for infestation. Numbers of tomatoes, cucumbers, etc., however, have been condemned for containing maggots, probably of the melon fly.

The conditions around the port of Honolulu are very promising for California's safety. The clean culture campaign has improved things, so that now it is a hunt to find infected fruit in the quarantined area, when three months ago almost every dooryard contained some.

The greatest hope is that an effective parasite will be found and established.

QUARANTINE AGAINST GYPSY MOTH (Porthetria dispar) AND BROWN-TAIL MOTH (Euproctis chrysorrhoea).

By O. E. Bremner.

The history of the spread and the devastation wrought by the two moths, Gypsy and Brown-tail in the New England states, is one the most widely-known cases of foreign insect invasion in the United States. It is, however, not so well known, and probably far more disconcerting to the lumbermen and orchardists of California, to learn that seldom a year passes during which the horticultural quarantine officers of this State do not take, in their inspection work, one or both of these insects on nursery and ornamental stock from Europe and Japan. Egg clusters of the gypsy moth were taken on trees from Japan in 1911 and again this year. Nests of brown-tail on French seedlings have been repeatedly taken during 1909 and since that time. The United States Department of Agriculture report that importations of European nursery stock during the season of 1909 and 1910, in twenty-two different states, were found to contain these nests.

Of the many instances occurring in California, one is reported where a shipment of seedlings was found to harbor over a hatful of these brown-tail moth nests.

The brown-tail moth occurs far more frequently in these foreign shipments, and is, by far, the most easily detected. This moth has a peculiar habit of hibernating in the larval state in a nest (Figs. 54

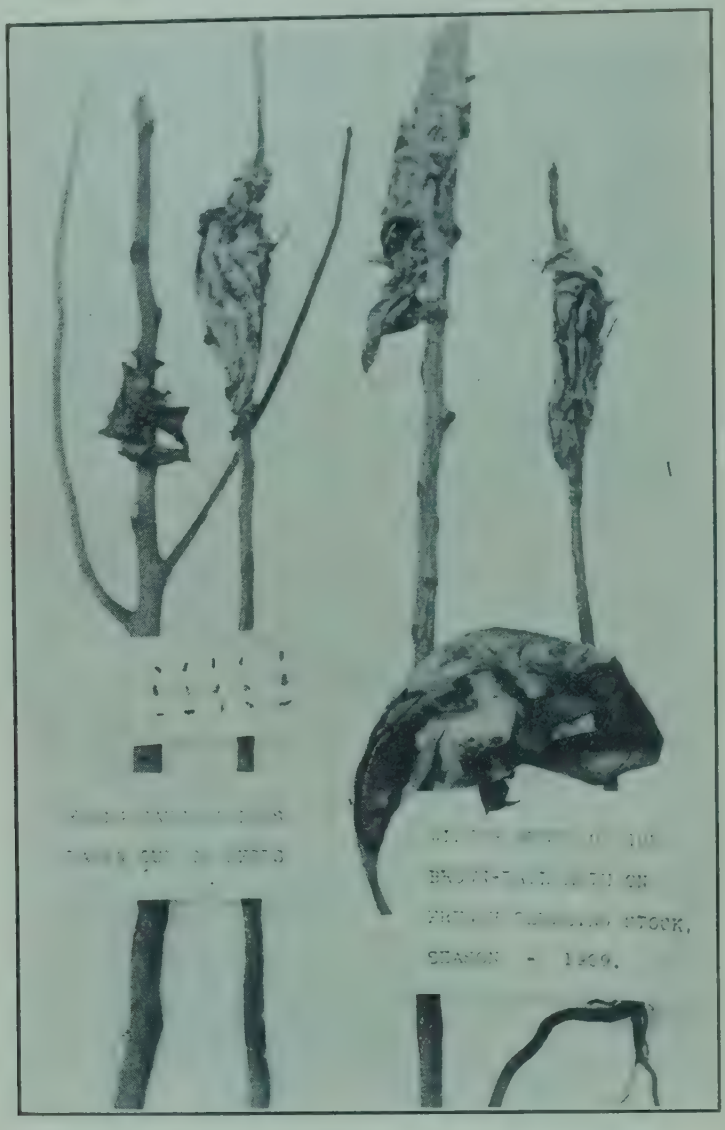

FIG. 54.—Nests and young of the brown-tail moth. (Original.)

and 55) which is composed of one or more leaves drawn together and spun up in a silken web or sack. The larvæ inside are quite small, and might themselves easily escape detection. Just as soon as the leaves start in the spring these small caterpillars come out of their winter nest and commence work, and so voracious are they that in sections of the New England States trees are killed in a single season from the results of the complete defoliation which they cause and maintain during this time.

While we are convinced that the only successful method of controlling this situation is the preventive means employed through the agency of our county and state quarantine officers, still there is always the possibility of a chance introduction, as these men can not be held to be absolutely infallible in their inspection. It is, therefore, always very good policy for nurserymen, growers, and even commissioners and inspectors, to be on the watch and refer any suspicious or doubtful larvæ to authorities for identification.

The egg clusters of the gypsy moth have in both instances from Japan occurred on *Thuya obtusa*, an evergreen, ornamental, dwarfish tree with bark resembling our California redwood. These egg clusters occur in patches consisting of many hundreds of eggs. The clusters in texture slightly resemble that of the Tussock moth, so common in this

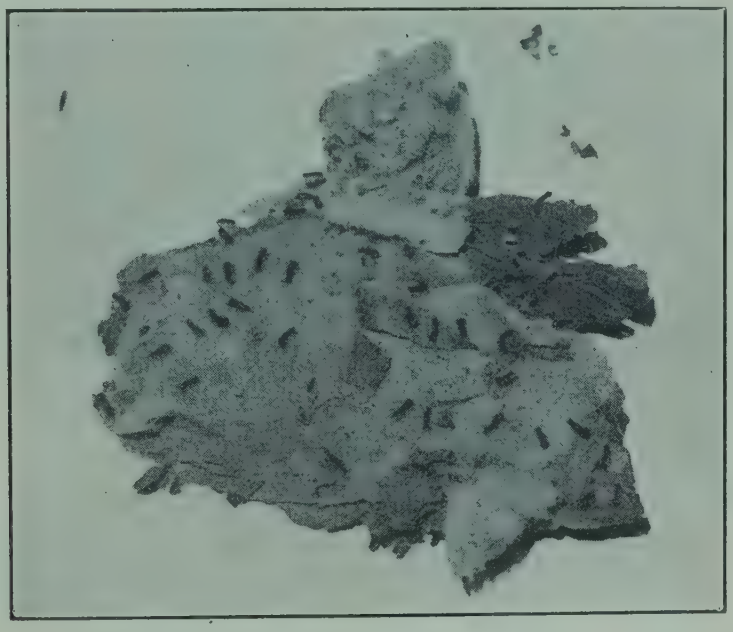

FIG. 55.—Nest of brown-tail moth, showing the newly hatched caterpillars. (Original.)

State, but are much larger, more flattened, and of a light tan color, which contrasts well with the dark brown bark. We are quite convinced that the *Thuya* is not a favorite host tree of this moth, but that these shrubs are grown in the shade or in close proximity to some deciduous tree on which the moth larvæ are feeding. The female moth undoubtedly lays her eggs on the trunk and larger branches of the *Thuya* so that they may be afforded better protection during the winter months. This very same thing might easily happen respecting evergreens imported from Europe or the Eastern States.

In case gypsy moth egg clusters are found, the only safe thing to do is to immediately cut off the cluster and burn, great care being taken in this operation that the cluster is not broken and the eggs scattered on the ground. Do not spare the tree, but remove plenty of surrounding bark with the cluster. The tree should then be destroyed as some

small scattering clusters may have escaped detection. If the trees are small and can be handled easily, the whole tree can be burned without removing the clusters. A gasoline torch can also be effectively used to destroy the clusters.

In the treatment of seedlings infested with brown-tail moth nests, the trees need not necessarily be wholly destroyed. First, fumigate the shipment with a dosage of 2 ounces of cyanide to the 100 cubic feet of space, then cut the seedlings for planting, taking care that they are cut short enough to remove the nest well below its point of contact with the tree. These tops which contain the nests should be placed on the fire at once. A canvas should be placed under the block where the cutting is done so that no nests could possibly escape.

Under no condition should nurserymen be allowed to hold seedlings which are from a suspected district any length of time without inspection. This is absolutely necessary, as seedlings arrive in California during weather which will cause the larvæ in the nests to soon become active. This same weather which causes the activity of the brown-tail moth larvæ will also hatch the gypsy moth eggs.

So far we have not had a single report of either of these moths in any stage occurring in California, excepting when taken in quarantine. Let the good work continue.

THE CITRUS THRIPS, WITH REFERENCE TO OTHER SPECIES AFFECTING CITRUS.

By A. W. Morrill,

Entomologist of the Arizona Horticultural Commission and of the Arizona Agricultural Experiment Station.

Four species of thrips have been recorded as injurious to citrus in the United States. These, in order of their present importance as citrus pests (beginning with the least injurious) are: A species to which no common name seems to have been applied, *Heliothrips fasciatus;* the greenhouse thrips, *Heliothrips hæmorrhoidalis;* the grain thrips, *Euthrips tritici;* and the citrus thrips,[1] *Euthrips citri.*

The first mentioned is recorded by Mr. Dudley Moulton as a citrus pest. In a publication issued in 1907,[2] he states that this species has been taken from orange in Colusa County by Mr. E. K. Carnes. In a latter publication (1911),[3] he notes that "This insect is a serious pest on oranges, alfalfa, pear trees and various garden crops."

The second of the species listed above is of almost cosmopolitan distribution as a greenhouse pest, but not until 1911 was it recorded as a citrus pest. This record is by Prof. H. J. Quayle,[4] who states that this insect "has been observed to do even more serious injury than the *citri* species" in three or four cases of a few trees each.

[1]The common name "orange thrips," as used by previous writers, is misleading, as shown hereafter under the subject of food plants of this species.
[2]Tech. Ser. No. 12, Part III, Bur. of Ent. U. S. Dept. Agrcl., p. 52.
[3]Tech. Ser. No. 21, Bur. of Ent. U. S. Dept. Agrcl., p. 24.
[4]Bul. No. 214, Cal. Agrcl. Exp. Sta., pp. 491-492.

The grain thrips, the third species mentioned in the opening paragraph, was recorded by Hubbard[1] as very numerous in orange blossoms, but not as injurious except when present in excessive abundance. Mr. Moulton[2] and Professor Quayle[3] have each mentioned the supposed connection of thrips with a certain discoloration of orange rinds in the form of brownish spots, but Professor Quayle calls attention to the fact that there is no foundation for this idea. The first definite record of injury to oranges by the grain thrips is by Messrs. Jones and Horton,[4] who state that this species is responsible for the occasional scarring of oranges in the north central portion of California. Injury to oranges, as observed in Florida, by what is no doubt the same species, has recently been well described and illustrated by Mr. H. S. Fawcett.[5]

The citrus thrips is the only one of the four species herein considered which has as yet attained a position of definite importance as a citrus pest. This species, however, has been associated with the injury hereafter described only during the past four years. Demands for an investigation became urgent in 1908, and beginning with the season of 1909, the United States Bureau of Entomology has conducted extensive experimental and demonstration work in the San Joaquin Valley of California. An investigation of the same insect on a smaller scale, with special reference to local conditions, has been undertaken in the Salt River Valley of Arizona by the writer. Two reports have been published by the Bureau of Entomology, the first in 1909 by Mr. Dudley Moulton[6] consists of brief notes and the original description of the species, and the second in 1911 by Messrs. Jones and Horton,[7] is a report of investigations during 1909 and 1910. A brief note concerning the extent of thrips scarring in the Salt River Valley was included by the writer in his report as Entomologist of the Arizona Agricultural Experiment Station for the fiscal year ending June 30, 1910. A report of some of the more important features of the work conducted in Arizona during 1911 is included in the forthcoming report of the same station for the year ending June 29, 1911. It is the aim of the present paper to summarize the more important facts in regard to thrips injury to citrus fruits and the foliage and the methods of preventing or reducing this injury. Unless otherwise indicated, the statements included herein concerning thrips and their injury relate to the citrus thrips.

Characteristics of Thrips Injury.

According to Fawcett, the grayish scars on oranges caused by thrips consist of a delicate scurf made up of minute pieces of the outer epidermis, under which a new set of cells has been formed. These scars result from the feeding of the insects when the fruit is very small, and

[1]Insects Affecting the Orange, Div. of Ent. U. S. Dept. Agrcl. 1885, pp. 164-165.
[2]Tech. Ser. 12, Part III, p. 40, Div. of Ent. U. S. Dept. Agrcl.
[3]Loc. cit., p. 493.
[4]Bul. No. 99, Part 1, Bur. of Ent. U. S. Dept. Agrcl., p. 2.
[5]Bul. No. 108, Fla. Expr. Station, pp. 32-33.
[6]Tech. Ser. 12, Part VII.
[7]Loc. cit.

with the citrus thrips occur in their most characteristic form as a ring (Figs. 58 and 59) surrounding the stem end of the fruit, frequently with irregular streaks running down from this ring. Irregular scars on the sides and blossom end (Fig. 60) are ordinarily present, but are not

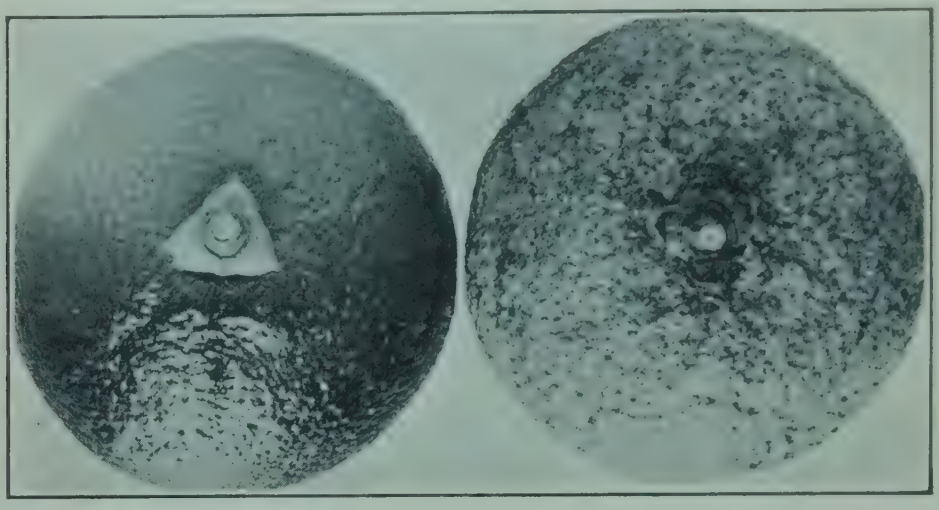

FIG. 56.—Work of the greenhouse thrips (*Heliothrips haemorrhoidalis*) on oranges. (Cal. Agrcl. Exp. Station.)

as characteristic as the ring referred to, although even this is not invariably found on scarred fruit, as after the fruit is a few weeks old the feeding of the citrus thrips causes only a slight silvering of portions of

FIG. 57.—Work of greenhouse thrips (*Heliothrips haemorrhoidalis*) on orange leaf. (Cal. Agrcl. Exp. Station.)

the surface. Quayle describes the work of the greenhouse thrips on the fruit (Fig. 56) as causing the entire surface to have a pale silvery color. The occasional scarring of citrus fruits by the grain thrips as observed in Florida is quite similar to the scarring caused by the citrus thrips in

California and Arizona, differing principally in that the ring around the stem end of the fruit is not a characteristic feature.

The citrus thrips causes a characteristic crinkling and thickening of citrus foliage, checking the growth materially. This injury is done when the leaves are very young and tender, beginning just as the buds are unfolding. The grain thrips is not recorded as injurious to citrus foliage. The greenhouse thrips in the instances recorded by Professor Quayle produced a mottled pale coloring of the foliage (Fig. 57) and resulted in the shedding of many leaves.

Extent of Damage by the Citrus Thrips.

In determining the profitableness of control measures a knowledge of the extent of the injury is essential. This subject is therefore given more prominence in this paper than would be considered desirable with insects whose damage is more easily calculated.

The scarring of fruit (Figs. 58, 59, 60 and 61) is usually considered the most important feature of damage by the citrus thrips to old bearing trees. Nursery stock and young planted trees, however, are frequently

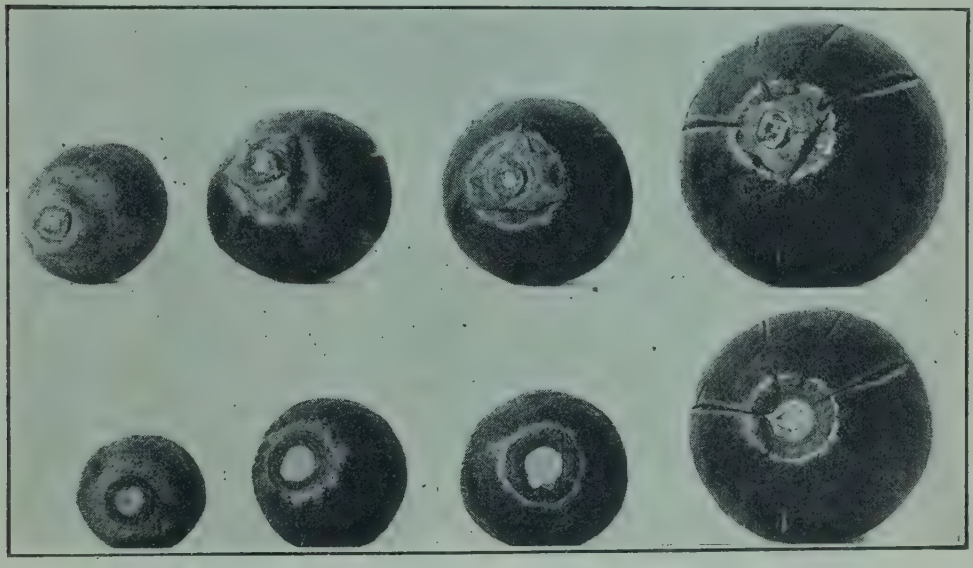

FIG. 58.—Work of the citrus thrips (*Euthrips citri*), showing characteristic rings at the stem ends of small oranges. (Cal. Agrcl. Exp. Station.)

severely injured by the checking and stunting of their growth. In the Salt River Valley it is difficult to successfully fill in vacant spaces in old bearing groves, owing to this injury. Even where the thrips are not plentiful enough to cause a considerable amount of scarring of the fruit, the minute pests seem to concentrate on replanted trees and retard the growth to the extent of one third or one half, and frequently prevent any development throughout an entire season. In the San Joaquin district, in California, nursery stock is quite severely damaged, Jones and Horton reporting an increase in fall growth of from one to two feet, resulting from the control of the thrips by spraying. In the Salt River

Valley, however, an exceptionally high grade of citrus nursery stock has been grown during the past two years in several different locations with hardly a trace of thrips injury to the foliage appearing up to this time.

In order to furnish definite advice to the citrus growers of the Salt River Valley, the writer, in his capacity as entomologist of the Arizona Agricultural Experiment Station, has made extensive examinations of fruit in the different groves before picking and later examinations at

FIG. 59.—Work of the citrus thrips (*Euthrips citri*) on navel oranges. (Cal. Agrcl. Exp. Station.)

packing-houses after the fruit was graded. In the field it was found that the injury to navel oranges ranged in different groves from none at all to about 60 per cent, scarred sufficiently to affect the market value. The bulk of the last crop of navel oranges was packed in three grades. Approximately, 28 per cent of the total number of oranges, which would otherwise have graded as No. 1, were graded as No. 2, while approximately 25 per cent of the total number which would otherwise have graded as No. 2 were graded as No. 3. Less than 1 per cent of the total were thrown out as culls entirely or partly on account of thrips'

scarring. Thrips' scarring affected the grading of more than 50 per cent of the fruit.

As is generally known, Arizona navels normally demand a high price on account of their maturing earlier than navels grown elsewhere. The first shipments of the season usually top the market by a wide margin. It is not surprising, therefore, that the difference in returns for the first and second grades should amount to as much as $2.00 a box in some instances, and that this difference is rarely less than 80 cents per box. Mr. Moulton[1] has recorded an observation made in a packing-house in Tulare County, California, that 30 per cent of the fruit was passed from first to second grade and 5 per cent passed as culls, owing to thrips' scarring, stating in this connection that the difference in price between the first and second grades was about 40 cents per box. These differences in market returns for the different grades do not include the entire loss in the selling value of the fruit. The writer has ascertained that the market value of fruit is frequently affected by 10 or 12 per cent of

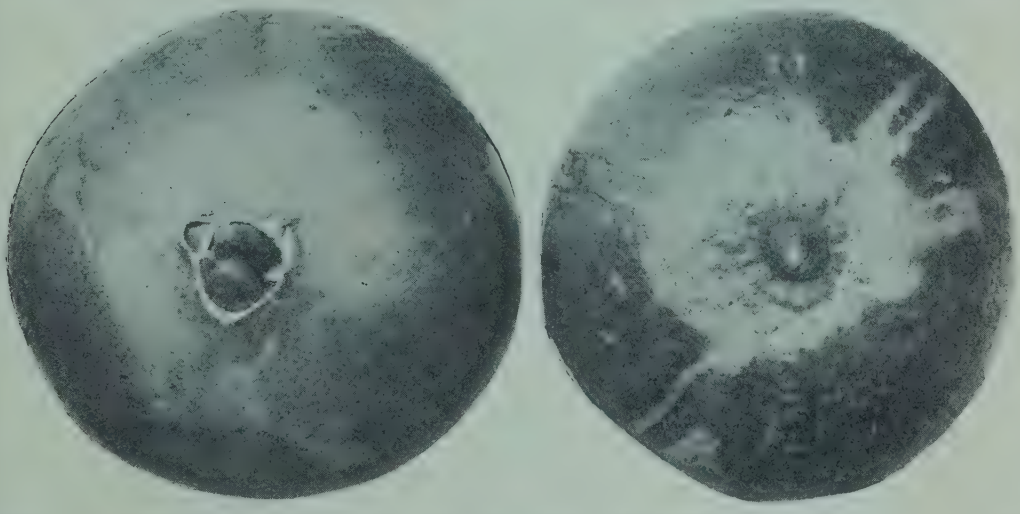

FIG. 60.—Work of *Euthrips citri* on navel and stem ends of orange. (U. S. Dept Agrcl.)

more or less noticeably scarred fruit being overlooked by the graders and passed as first grade.

Contrary to general opinion, the pomelo or grapefruit is subject to much damage by the orange thrips. In one instance, to the knowledge of the writer, a grower lost one dollar per box for his entire crop, owing to the prevalence of thrips' scarring.

Aside from the few fruits which are misshapen and otherwise poorly developed, owing to excessive scarring of the orange thrips, the edible quality of the injured fruits is not affected by the scarring on the rinds. Nevertheless, citrus growers in affected districts are compelled to heed the demands of the markets or else suffer losses in the returns for their citrus crops, amounting as a rule to between one and three dollars per tree. Fortunately most of this loss is preventable at a moderate expense.

[1]Tech. Series No. 12, Pt. VII, U. S. Bur. of Ent., p. 120.

Food Plants of the Citrus Thrips.

All citrus fruits so far as observed are subject to attack by the citrus thrips, though the insects have shown marked preferences for certain species and varieties. Of the oranges, the Washington navel seems to be preferred. Grapefruit, while not as a rule as susceptible as the Washington navel, sometimes is seriously damaged as instanced in a preceding paragraph. Lemons fortunately do not appear to be seriously affected. Tangerines, according to the writer's observations in Arizona, are more subject to fruit scarring than Washington navels. Since all species of citrus fruits are attacked and since some varieties of oranges, St. Michaels, for instance, appear to be comparatively immune to injury by *Euthrips citri*, the writer considers that for a common name "citrus thrips" is not only preferable to the name "orange thrips," but that the latter is inappropriate and misleading.

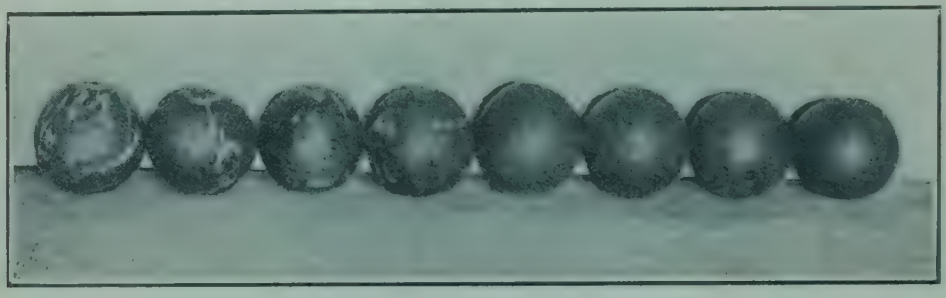

FIG. 61.—Work of the citrus thrips (*Euthrips citri*) in Arizona. The four oranges at the left show the scars produced by thrips, while the oranges at the right are perfect. (Photo by Ariz. Agrcl. Exp. Sta.)

Aside from citrus the following food plants are recorded by Messrs. Jones and Horton:[1] *Punica granatum* (pomegranate); *Vitis vinifera* (European grape, varieties of); *Schinus molle* (California pepper tree); "umbrella tree"; *Pyrus communis* (pear); *Prunus armeniaca* (apricot); *Prunus persica* (peach); *Prunus domestica* (European plum, varieties of) *Salix* sp. (willow); *Rumex* sp. (dock); *Portulaca oleracea* (purslane); *Olea europea* (olive); *Rubus idoeus* (red raspberry); *Rosa* sp. (rose); *Solanum* sp.

Description, Life History and Seasonal History.

The adult citrus thrips (Fig. 62) is a four-winged insect, orange yellow in color, measuring (female) about $\frac{4}{5}$ mm. or one thirtieth of an inch in length and $\frac{1}{4}$ mm. or one one-hundredth of an inch in width. This species appears broad in comparison with the grain thrips which is nearly one and a half times as long and scarcely wider. The grain thrips is further readily distinguished by being brownish yellow in color. Both species of the genus *Heliothrips*[2] reported as injurious to citrus are distinctly brown in color and as a generic characteristic differ from the citrus thrips and the grain thrips by having a deeply reticulate surface marking. For the specific distinctions aside from the

[1] Loc. cit., p. 3.
[2] See opening paragraph of this article.

above general characters, one should refer to Moulton's Synopsis, Catalog and Bibliography of the North American Thysanoptera."[1]

The egg, two larval and two pupal stages have been described fully and the duration of the stages has been determined by Jones and Horton. During the months of May to August, inclusive, the egg stage averages between 6 and 8 days, the two larval stages between 6 and 7 days and the two pupal stages between $3\frac{1}{2}$ and 5 days. The total life cycle from the deposition of the egg to the beginning of egg-

FIG. 62.—Citrus thrips (*Euthrips citri*). Photomicrograph of adult female. (Photo by Ariz. Agrcl. Exp. Sta.)

laying by the adult of the succeeding generation was estimated as about $18\frac{1}{2}$ days in 1909 and as 23 days in 1910. These investigations place the number of generations from 8 to 10 per year in the San Joaquin Valley.

The winter is spent in the adult form in various protected places. The insects become abundant soon after the majority of the petals of citrus trees fall and usually continue in abundance through the season until the latest fall growth has ceased to be attractive.

[1]Tech. Series 21, Bur. of Ent. U. S. Dept. Agrcl. 1911.

Habits.

The orange thrips is unusually active and runs, leaps and in the adult stage flies readily. The writer has found, however, that they do not, when desirable food is abundant, fly from tree to tree so rapidly as to prevent very striking results being obtained from adjoining rows of sprayed and unsprayed trees. In the absence or scarcity of desirable food in the citrus orchard, their activity in seeking a new food supply is as strikingly apparent as is their inactivity under other circumstances. The insects feed in the larval and adult stages. The mouth parts are suctorial or adapted to the sucking of plant juices, but it is supposed that the insects rasp the tender surfaces of the leaves or fruit upon which they feed. Their preference for new foliage and young fruit has been mentioned. The attack of the insects is practically limited to the exterior of the trees, only four or five per cent of interior fruit being scarred when outside fruit is scarred to the extent of 60 or 70 per cent. The pupal stages are inactive and are spent in hiding under the trees.

Control of the Citrus Thrips.

Cultural methods of control are reported by Jones and Horton to have been attempted in California without success. An attempt is being made by the writer to determine if there is any relation between cultural methods and the wide difference in the abundance of the citrus thrips in different citrus groves in the Salt River Valley. The results so far obtained are quite suggestive and it may be said appear promising, but so far are not sufficiently conclusive to discuss in a popular article of this kind.

The citrus thrips may be controlled by spraying as shown by the results reported by Jones and Horton. In one experiment with three applications of spray they secured 74.5 per cent of unscarred fruit as compared with only 14.5 per cent of unscarred fruit in an adjoining block of unsprayed trees. In a second experiment they secured 59 per cent unscarred fruit as compared with 29.3 unscarred fruit on an adjoining unsprayed block. Similar results have been secured by the writer in the Salt River valley. In one experiment two applications of spray to a block of navel oranges consisting of about one acre produced 80 per cent unscarred fruit as compared with 65 per cent unscarred fruit in unsprayed trees immediately surrounding the sprayed block and 27 per cent unscarred for the entire grove outside of the sprayed block. It is evident from the foregoing results that from 30 to 60 per cent of the total crop of navel oranges in groves where the citrus thrips is very injurious can be saved from the losses which result from the reduction in the grade of scarred fruit. Much better results may be expected in districts where regular spraying is adopted as a practice in all groves.

As announced in a report which is in press at this writing[1] the writer

[1]Report of the Entomologist in Report of the Ariz. Agri. Exper. Sta. for fiscal year ending June 29, 1911.

in two experiments secured fully as good results with lime-sulphur solution 36° (Baumé) diluted at the rate of one part to 85 parts of water as with the lime-sulphur (1–85) and tobacco extract (40 per cent nicotine, 1–1800) combination. This result is corroborated by the results secured during 1911 in Tulare County, according to information received by letter from Mr. J. R. Horton of the Bureau of Entomology. In Arizona the diluted lime-sulphur spray costs about 45 cents per hundred gallons as compared with about $1.00 per hundred gallons for the combination with tobacco extract.

The writer has been unable to discover any injury whatever from applications of lime-sulphur solution in his experimental work. He is indebted to Mr. Horton, however, for a statement in regard to injury by lime-sulphur as observed by him in connection with his experimental work for the Bureau of Entomology. This statement combined with the writer's observations in Arizona show that injury of this kind is practically negligible, especially in consideration of the damage done by the insects when uncontrolled.

Jones and Horton recommend four applications per season timed as follows:

First. Just after most of the petals have fallen.

Second. Ten to fourteen days after the first.

Third. From three to four weeks after the second.

Fourth. In August or September when thrips are numerous for the protection of late growths of foliage.

The foregoing schedule is applicable to localities or groves where the insects are excessively abundant. In many cases which have come under the writer's observation individual groves show injury extensive enough to warrant one or two applications, but not more. Under such circumstances one or two applications may be as effective as three or four in groves with less favorable surroundings. Citrus fruit growers in affected sections should learn to recognize a threatening condition of infestation and arrange their schedule of spraying accordingly.

In spraying for the citrus thrips the most modern high power equipment is very desirable. The writer has secured striking results with pressures of 140 and 160 pounds, but for the greatest economy and efficiency 175 to 200 pounds pressure is preferable with large capacity nozzles and two leads of hose. Angle nozzles or elbow joints are necessary in order to spray both upper and lower surfaces of the leaves. Care should be used to avoid insufficient spraying. Thorough drenching, especially of the outer portions of the trees, is essential for the best results.

WOOLLY APHIS—KEROSENE EMULSION.

By A. J. Cook.

Since assuming the duties of the office of State Horticultural Commissioner last November, I have received very numerous inquiries regarding the arch-enemy of the apple trees, the woolly aphis (*Schizoneura lanigera.*)

We learn that seven state experiment stations are now engaged in a thorough study of this pest. Only two other insects are receiving like attention; the peach-borer (*Sanninoidea exitiosa*) and the codling-moth (*Carpocapsa pomonella*). These two facts, coupled with the withering effects of its attacks, warrant a short article regarding this aphid for our Monthly Bulletin.

The generic name refers to its woolly covering. This fibrous secretion serves to protect its owner from attack of insects and birds. Who of us does not remember the single bite, on some April 1st, from a cotton-stuffed doughnut? The cotton was not palatable and so we

FIG. 63.—Woolly Aphis (*Schizoneura lanigera*). *a*, root injury by subterranean form; *b*, wingless, and *c*, winged aerial forms. (U. S. Dept. Agrcl.)

desisted from a second bite. No more the woolly aphis for hungry birds. Again, this plant louse is unique in the double habit of working in part on the twig, especially water sprouts, which they often whiten as though they were snow covered; and also, on the roots of apple and pear, where they work their maximum mischief, and where from their garments of white they are easily detected, if the orchardist does a little digging. A badly infested tree looks sick, and this sickness is often unto death. The snow-white twigs are always indicative of root affection. Often great swellings — gall-like tumors — upon the roots indicate the seriousness of such woolly aphis attack.

Elaborate experiments by Prof. R. I. Smith, State Entomologist of Georgia, conducted some years since, proved that kerosene emulsion was the best specific remedy against the root form of this aphid. Professor Smith tried many compounds, especially of kerosene and tobacco decoction. He found that a 15 per cent kerosene emulsion was entirely effective against the root form of the woolly aphis (Fig. 63.) Young trees from the nursery containing the lice should either be destroyed entirely or, after thoroughly washing the roots, dipped for one and one

half minutes in the emulsion. For orchard trees a hole 6 inches deep and 3 feet more or less in diameter, according to age and size of tree, is dug about the tree, and from 3 to 5 gallons of the 15 per cent emulsion is poured into this excavation. As soon as the liquid has disappeared, the hole is filled. All of the lice that are touched are surely killed. Those distant from the tree may not be killed, but the odor and presence of the emulsion, which persists for months, will prevent their approaching the tree. New rootlets will form and very soon the tree will again be in full vigor. One application a year will suffice, and it was found that in two years the lice were all destroyed and the trees in full health. The treatment should be given in late spring, as the trees are then in such thrift that they are not injured by it. This is not true when the trees are dormant.

The aerial form succumbs to a solution of potash-whale-oil soap, one pound to six gallons of water. If this can be applied warm, all the better. Another effective compound consists of Blackleaf Tobacco Extract, one gallon to 70 gallons of water, in which three pounds of potash-whale-oil soap has been dissolved. This is very easily and cheaply prepared. As in all cases of the use of sprays, much force should be used in making the application, for, as the effectiveness depends upon contact, the insecticide must strike all the lice, which will not be true unless a high pressure is used.

Of course, in procuring stock upon which to graft, the Northern Spy variety should always be selected, as this variety is very resistant to the woolly aphis. It is also a very vigorous stock, but a variety that is slow to come into bearing.

The writer was the first to make the kerosene emulsion, so far as he has knowledge. He stumbled on to it a year before Mr. Hubbard, under the direction of Professor Riley, made his elaborate experiments. The fact was published at the time, but the importance of the discovery was not appreciated. The first emulsion was formed by use of soft soap, very hot rain water, and not more oil than water. The mixing was also performed by use of a hand force pump, pumping the liquid back into itself. Many have had difficulty in making the emulsion, which is easily known from its cream-like appearance. Would we succeed easily, we must always use soft water, must have it hot, and if soft soap is at hand, the emulsion will be speedily and easily formed. Other soap may be used (a potash-whale-oil soap is excellent), one pound to four gallons of kerosene. In the common formula (Riley-Hubbard) two gallons of kerosene to one gallon of water are used with one half pound of soap. The soap is dissolved in boiling water and the kerosene added. If the day is cold, the oil so cools the mixture that it is often quite impossible to form the emulsion, especially when hard water is used. If we could safely heat this to near the boiling point, the difficulty would be far less. It is not safe to have kerosene too near the fire.

I found kerosene emulsion a great specific remedy against cattle lice in winter. The same is true of horse and hog lice. I found great diffi-

culty on cold days to secure an emulsion, except as I lessened the proportion of oil, and so of course preserved more of the heat.

In making a large amount of the emulsion, the force pump, pumping the liquid back into itself, is excellent. For a small amount, often desirable to use on house plants, an egg-beater will answer admirably.

TWO METHODS OF CONTROLLING CITRUS MITES.

By J. A. Prizer, Entomologist, San Diego Fruit Company, Chula Vista, Cal.

The past fall and winter seem to have been very favorable for citrus mites of all kinds, and especially has this been true in San Diego. Here both the Red Spider (*Tetranychus mytalispidis*) and the Six-spotted Mite (*Tetranychus sexmaculatus*) have become quite formidable pests and have been the cause of considerable loss within the past six months. The long continued drouth has made possible their rapid increase and the numerous hot winds seem also to have been to their liking.

In fighting these pests two methods have been most widely used; the application of dry sulphur, thrown on by hand, and spraying with a commercial lime and sulphur solution. Since these methods have been so extensively employed in this section, especially by the San Diego Fruit Company, we have received numerous inquiries and requests for advice as to which is the better method to pursue. It is the aim of the writer to try and answer some of these questions in this article.

Early last July the six-spotted mite (Fig. 64) began to show up in one or two orchards, and as the weather conditions were at that time considered ideal for dry-sulphuring, this method was used. In August it appeared in several other orchards, and as these had previously been severely injured by "wither-tip," it was thought best to use the commercial lime-sulphur, in order to try and check any further advance of this disease, as well as to kill the mites. The spraying began about the 5th of August and was continued throughout the fall and winter, until over four hundred acres had been sprayed. No dry sulphuring, except for experimental purposes, was done after October 15th.

In this campaign against the mites, two things have been clearly demonstrated. The first is that under certain conditions spraying is the only safe and sure method of fighting them, and the second, that under ideal conditions of weather — a night when there is plenty of dew followed by hot days — the dry sulphur may be put on and the very best results obtained. In one orchard of forty acres which was dry sulphured July 24th we have not had to give a second treatment because of mites up to the present time. But an adjoining orchard, which was dry sulphured the 14th of the same month, became so badly infested in August that it was sprayed with the lime-sulphur solution. Both were equally infested when first treated, but in the case of the former weather conditions were ideal.

But in considering winter treatment when the days are cool and there is the possibility of rain washing off the dry sulphur, the spray has

everything in its favor. Repeated sulphuring in the nursery served only to keep the mites down for a short time. An experiment was made for the purpose of comparing the results of winter spraying and dry sulphuring. One row of twenty-seven trees was treated with dry sulphur, the rows on each side of it with a 3 per cent solution of the spray and another row left as a check. The sprayed rows were treated January 13th, and the following morning, when the leaves were still wet with dew, the row set aside for dry sulphur was treated. The days following were as warm as any we usually have in January (averaging about 57°), but when these rows were compared the first of February, both the check and the dry-sulphured rows were still covered with red spider—little difference being noted between them—whereas a careful examination of a half dozen trees on the sprayed rows failed to show a single mite. In order to be sure that the method of application was good, two orchards that had been dry sulphured in the daytime with a powder blower were examined and these seemed to be as badly infested as the trees sulphured by hand.

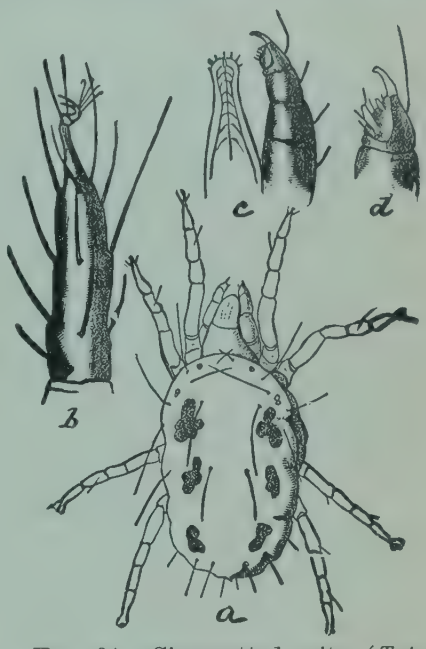

FIG. 64.—Six-spotted mite (*Tetranychus sexmaculatus*). *a*, adult; *b*, tarsus; *c*, rostrum or beak and palpus; *d*, tip of palpus. (U. S. Dept. Agrcl.)

In killing effect the spray is excellent upon the mites in all stages of development. Out of 100 eggs of the red spider taken from leaves sprayed with a 2 per cent solution and placed in the laboratory no mites were hatched. The young die almost as soon as the spray comes in contact with them, but in the case of the adult it may be two or even five days before they all die. On the six-spotted mite the effect of the spray is quicker, but in spraying for it, the lower sides of the leaves must be hit. This mite, working on the under side and irrigating the lower epidermis, causes the leaf to curl and fold into pockets. The colonies of the six-spotted mite are found within these pockets, and are still further protected by a thin web which extends across the opening, so that to hit them, the spray must be forced up and out through the foliage. Many claim that it is the fumes of the spray that have the killing effect and that only the lower parts of the tree need be sprayed, but experiments have been made to determine this point and these showed conclusively that for either the red spider or the six-spotted mite the application of the spray must be thorough and cover all parts of the tree.

Some criticism has come on account of damage done to fruit and foliage with a commercial lime-sulphur solution. On one experimental plot we used as high as 4 per cent of the Rex lime-sulphur solution without damage, but this is certainly not advisable. In nearly all of

our winter spraying we have used a strength of 3 per cent and so far can find no damage, but this is a possibility which has always been taken into consideration, and whenever we have had hot, dry days the spraying has been stopped entirely or the strength cut down to 2 per cent. A strength of 2 per cent, or about 5 gallons to the 225-gallon tank, is probably the safest and best to use and should not be exceeded in districts situated back from the coast. Considerable damage was done to the fruit and foliage in last summer's spraying with a 3 per cent solution mixed with an 8 per cent solution of kerosene for purple scale, and even the lime-sulphur alone dropped some of the leaves when applied during hot weather. In the interior districts it would probably be inadvisable to use the spray at all during the summer months, but as the worst infestations in these sections occur during the spring, the orchards could be cleaned up during the early cooler weather.

The cost of the lime-sulphur solution, as in the case of any other spray, depends upon a number of variable factors. The actual cost of the material, the cost of labor and the rate and the amount of the application must all be considered. In all spraying done by the San Diego Fruit Company, power sprayers have been used. These have been equipped with four lines of hose and each hose with two of the Bean "whirlpool" power nozzles of the angle form. These nozzles throw a strong heavy spray, forcing it into all parts of the tree, and are clearly the most economical and satisfactory we have tried for this work. The spray has been applied under a pressure of 200 pounds, and with machines equipped in this manner we have been able to average about 2,225 gallons per day with each. This has made the cost average about five cents a tree for one application.

The red spider is certainly a most serious drain upon the vitality of the tree and the six-spotted mite, if anything, an even worse pest. Not only are they dangerous in themselves, but the red spider especially is the means of scattering thousands of the "wither-tip" spores over the surface of the tree and through the innumerable punctures made by his beak. The hyphæ of the germinating spore find easy access to the otherwise healthy tissue. In order to save the damage, which must inevitably follow their rapid spread through the orchard, it is best to strike quick and hard and for winter treatment at least the lime-sulphur solution seems a certain means of attaining this end.

In conclusion the following points may be emphasized:

1. Dry sulphur, if applied under favorable weather conditions, may be as lasting and efficient in its effects as the spray.

2. If applied during cool weather it will, in all probability, fail absolutely even if applied two or three times.

3. The commercial lime-sulphur solution for winter treatment is to be prefered to the dry sulphur, because of its quick killing effect and its value as a fungicide in keeping down any fungi that may be present on the trees.

4. The spray should be put on at a strength of 2 per cent, or about 5 gallons to the 225-gallon tank, and the whole tree covered.

5. It is not advisable to use the spray during the hot summer months.

AN EXPLANATION OF THE HIBERNATING HABITS OF HIPPODAMIA CONVERGENS.

By Edward K. Carnes.

In the third number of the Monthly Bulletin, there appears an article by the writer, explaining the work of collecting ladybirds (*Coccinellidæ*) by the ton.

This work has been pursued by the California State Insectary for several years past, and many tons of the species *Hippodamia convergens* have been collected, successfully held in artifical cold storage, and distributed during the early summer to the various growers of this State, with most gratifying results.

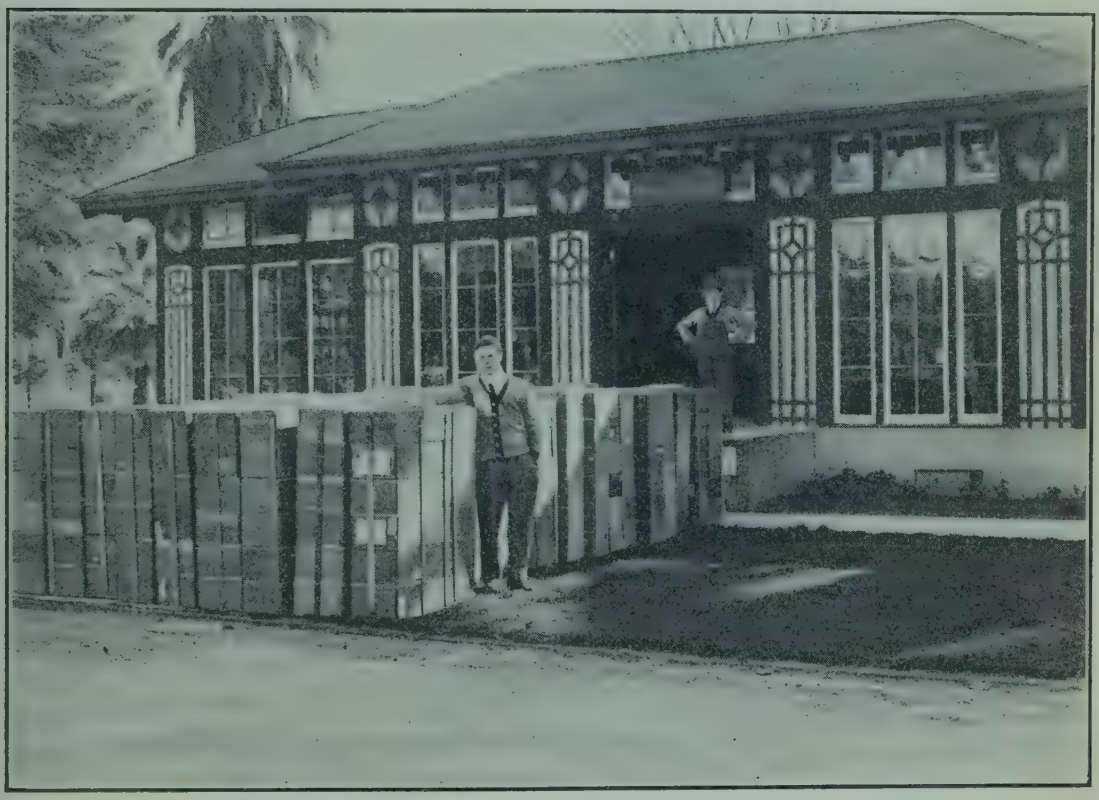

Fig. 65.—Showing 896 colonies or 29,687,168 individuals of *Hippodamia convergens* ready for shipment, in front of the California State Insectary.

The following paragraph appeared in said article:

"So far, we have been content with the knowledge that enormous quantities could be procured, and that they practically return to the same place each winter, but we are now working along lines to determine why they are attracted in such numbers to these particular spots. This phase of the subject will be treated separately, probably in the next issue of the bulletin, with the hope that it may bring forth considerable discussion on this point which will be of material use in arriving at a satisfactory solution of this phenomenon."

The purpose of the present article is an attempt to explain our theory of the peculiar habits of this particular species. While it is not the intent of the editorial staff of the Monthly Bulletin to present absolutely technical scientific articles, or to incorporate, in the various articles submitted, any scientific terms or technical descriptions that will not be absolutely readable to the layman, yet in this progressive entomological and horticultural age, where continual advancement is ever being made, it sometimes becomes necessary to make use of certain newly coined scientific phrases, in order to clearly set forth the meaning of an article.

In the past our growers have rather frowned upon such writings, but we are rather of the opinion that the general horticultural and entomological advancement of this State is such, that when necessary we may present them in the interests of true advancement. At first glance they may appear rather formidable to a majority of our readers, but by embracing them at once, will obviate the necessity of associating a popular term, and again later learning the scientific term for many of the intricate actions of insect species; it will also avoid confusion later on. As an example, when the South African hymenopterous parasite, *Scutellista cyanea*, was first presented to the growers of this State a cry arose immediately, suggesting that this species simply be called "scutes." This, however, met with considerable objections from entomological sources, and the use of the entire name, *Scutellista cyanea*, became general, and now the State Insectary is in receipt of thousands of letters from various growers over the State, asking for colonies of *Scutellista cyanea*. The same rule also applies to the names of our other beneficial insects. It, therefore, shows that it is as easy for the average layman to embrace the scientific term immediately, as it is some common phrase, which actually means nothing, and is only a source of confusion and trouble throughout later years.

In the subject under discussion, the ambiguous terms "*instinct*" and "*intelligence*," which in the past have been applied to the factor governing practically all insect action, have been discarded, and they are now both classified under the head of "*Tropisms.*"

A reflex act, or a combination of reflex acts, were in reality termed an "*instinct*"; therefore, in speaking of a tropism or tropisms, we now mean reflex acts, or a combination of reflex acts. Probably the true solution of these complex questions governing the intricate behavior of insects, will come through the study of tropic reactions, which, though comparatively new, has added much to our present knowledge of the subject, at the same time causing many of our traditional teachings to topple and fall, but giving us a more satisfactory basis from which to work, and may in a few years more, at the present rate of advancement, eventually be explained under the caption of some of these newly erected divisions of tropisms, each of which has a distinct individual explanatory value, explaining as it does, the peculiar action of insect organisms while reacting to certain tropic influences.

The experiments made by Loeb, Wheeler, Wasmann, Davenport, and Kellogg, opened a new field of entomological research, in which the student encounters a complete new category of terms, under the general head of tropisms; each special tropic reaction is given a separate name in order to distinguish the various behaviors of organisms due to environmental influences, such as chemicals, light, moisture, temperature, contact with solids, water and air currents, gravity, etc., as shown by Fig. 66, substituting the term tropisms for instinct.

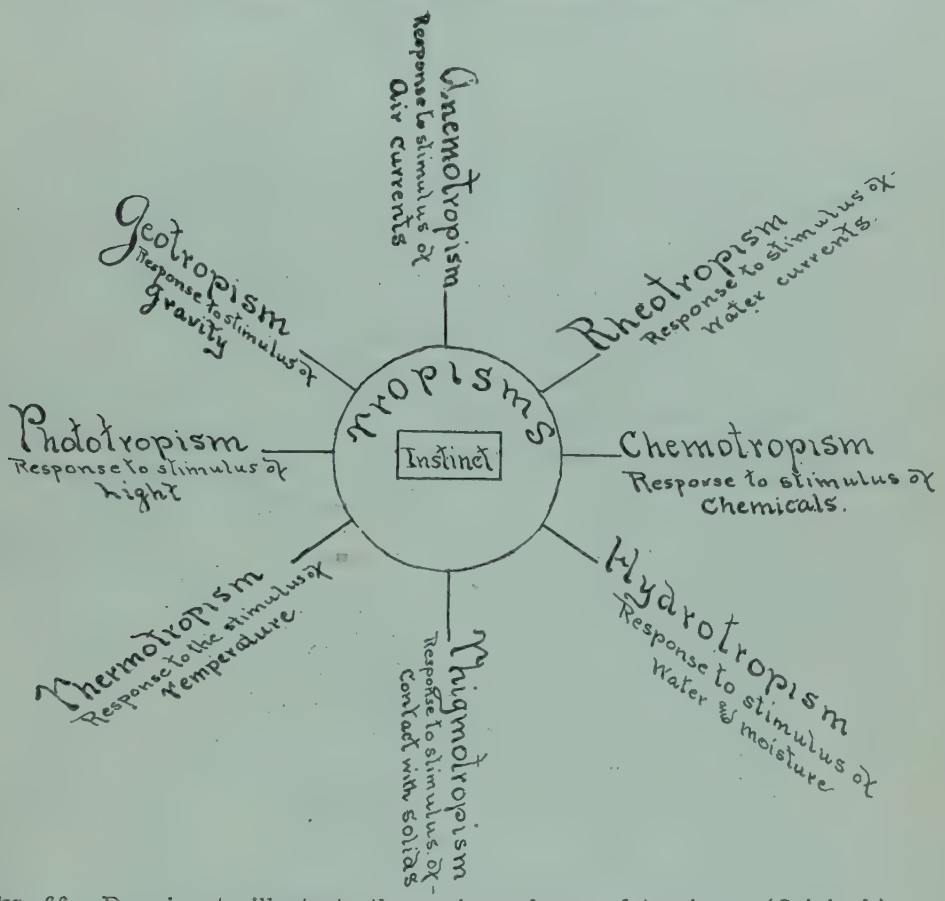

FIG. 66.—Drawing to illustrate the various phases of tropism. (Original.)

In substantiation of the fact that these new theories are generally accepted, we quote from Professor Kellogg, as follows:

> "What modern investigation has clearly and positively done is to cut away the anthropomorphism of the careless popularizer, and to compel a strong leaning toward a belief in the efficiency of reflex and instinct to explain more, if not all of ant behavior. What would not have been heard with any patience at all, a few years ago, that is, a purely mechanical, *i. e.*, reflexive reaction to physico-chemical stimuli, explanation of many of the "wonderful" actions of ants, as their perception of paths, their recognition of nest-mates, and swift attack on strangers, their refrain from attack on other species living in symbiotic realtions with them, etc., is now heard with careful attention."

The following specific cases will give the reader a general idea of what has been accomplished toward eliminating many of the popular fallacies, regarding so called insect intelligence, and which are the results of careful observation and painstaking experiments on the part of many of the deepest scientific thinkers of the present age.

Folsom tells us that although the well-known determination on the part of ants, between members of their own colony and those of other colonies, even of the same species, would seem to imply intelligent recognition. However, this recognition is due simply to a characteristic odor, which is derived from the mother of the community. An ant after being washed receives hostile treatment from others of its own colony; while

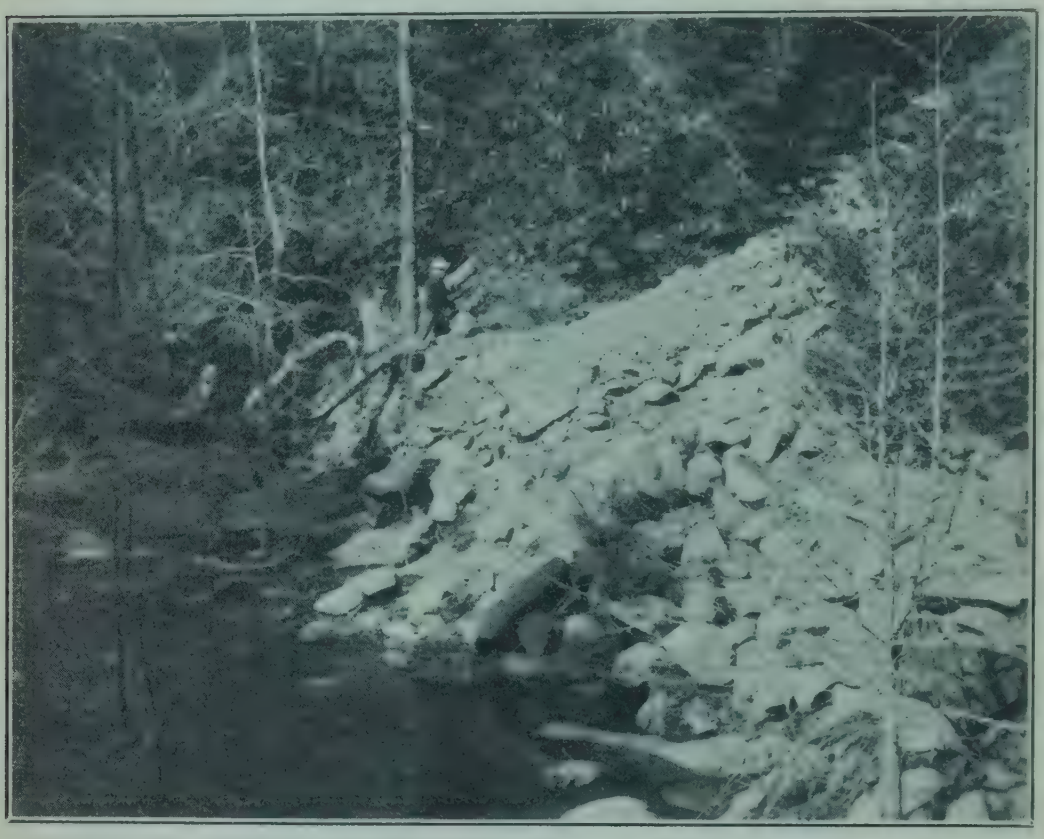

FIG. 67.—A sun spot showing typical location of colony. (Original.)

an alien ant, after being smeared with the juices of hostile ants, is treated by the latter as a friend.

Also that a tropic reaction occurs, whether it is to prove useful to the organism or not. Thus a ladybird beetle walks upward, on a branch, on a fence, or on one's finger; it walks upward as far as possible, and then flies into the air (Fig. 71.) If it happens to reach the tip of a twig and finds aphids there, the beetle stops and feeds upon them. A blow-fly will lay its eggs in meat, upon which its larvæ may feed, but the fly will not lay its eggs upon fat, upon which the larvæ could not feed, which would seemingly indicate what is popularly termed "*intelligence.*" Loeb has concluded that certain chemical stimuli from meat

cause the blow-fly to lay its eggs. In the fat these stimuli are lacking, but can be produced artificially. The egg-laying process in this case then is merely a mechanical response on the part of the fly to chemical stimuli.

Also in the case of a moth that arrives in its flight, just close enough to a flame to escape death, and flies in a perfect circle around the same, has popularly been ascribed, first to curiosity, and then intelligence on the part of the moth in avoiding direct contact with the flame. Loeb has also set at naught this seeming intelligence, and has demonstrated that this is simply the play of physical forces. The pushing effect of the heat just balances the pulling effect of the light, when the tension is just at an even balance, and the moth will spin round and round in a perfect circle. When the tension is uneven, the course described will be a series of zigzag movements.

In the case of the moth flying directly into the flame, Loeb insists that the moth "does not fly into the flame out of curiosity, neither is it attracted by the light; it is only oriented by it in such a manner that its median plane (an imaginary line dividing the body into approximately equal right and left halves), is brought into the direction of the rays and its head directed toward the source of light. In consequence of this orientation, its progressive movements must lead it to the source of light." Thus, the rapidly moving moth gets into the flame before the heat of the flame has time to check it in its flight.

From the experiments of Parker, this response to the stimuli of light is clearly shown in the case of the butterfly. When one eye is painted black, the butterfly creeps or flies in circles, with the unaffected eye always toward the center. When both eyes are painted black, all phototropic responses cease and the insect flies upward.

An excellent example of chemotropic response is furnished in the experiments of Kellogg with silkworm moth (*Bombyx mori*). Males of this species find the females exclusively by this response. A male with antennæ removed, though eyes be perfect, does not find the female, except by accident. The same insect with antennæ intact, and its eyes blackened, immediately locates the female. A male with left antennæ off when within three or four inches of a female moves energetically around in repeated circles to the right; a male with right antennæ off circles to the left under the influence of the odor emanating from the scent glands protruded by the female. If these scent glands be removed and placed alone in the immediate vicinity of the female, the male will proceed directly to the isolated scent glands and remain with them, absolutely ignoring the presence of the adult female.

It is a matter of common knowledge that male cats and male gophers respond to the stimuli of certain chemicals, and may be attracted in this manner from a long distance.

Bringing the matter down to date, I will cite a case of response to *chemotropism* within the last few months. During our experimental control work in Honolulu against the Mediterranean fruit fly (*Ceratitis capitata*) the use of kerosene traps was employed; it had been known

for some time that a shallow pan of kerosene, exposed in the open, would attract adult Mediterranean flies, and in a remarkably short time the oil would be completely covered with the bodies of dead adult flies. In an experiment conducted by Professor Severin of Honolulu, with oil pans in citrus trees (November, 1911), it was found that 10,203 males were taken, as against 36 females; an average of 291 males per day against 1 female, which was probably an accidental death in the case of the female. Undoubtedly, in this case, the males simply respond to chemical stimuli (marked males being drawn for half a mile) in the same manner that the males of silkworm moths respond to the odor from the female scent glands.

FIG. 68.—An example of *Phototropism* (light). (Original.)

This tropic reaction on the part of the males only of the Mediterranean fruit fly (*Ceratitis capitata*) would indicate that kerosene gives off an odor closely related to the sex odor emitted by the females of *Ceratitis capitata*, and would explain the "*popular mystery*" why the Mediterranean fruit fly will deliberately drown itself in a pan of kerosene — as before explained, a tropic reaction occurs, whether it is to be beneficial or not.

While the above experiment did not give us the solution of the control of the particular species in question, probably owing to the fact that the males were not captured until after the females had been fertilized, however, it adds materially to control work, the results being

accumulative. Its greatest value lies in the fact that it opens up a great field for chemical entomology and paves the way for new discoveries along the line of control work, through the use of artificial chemical stimuli, as traps against destructive insects.

It must be remembered that practically all of our present day scientific achievement had its conception in theory, and while entering this field may appear to be groping far into the future, the discovery of insect control by artificial stimuli, along with the true solution of insect behavior, may not be so far away, improbable as it may now seem.

Having explained the tropismic theory in regard to insect behavior, together with authentic verification of the same, which was necessary to enable the reader to more intelligently understand our theory of the hibernating habits of *Hippodamia convergens,* the particular species under discussion, we may now proceed with this theory, being a result of six years' study and experiment along this line.

The last brood of the season, upon reaching the adult stage, goes into hibernation, induced, no doubt, by the response to the stimulus of temperature (*thermotropism*), without depositing any eggs.

The mean monthly temperature for this season of the year, as taken from the records of the U. S. Weather Bureau, is as follows:

September	69 degrees Fahr.
October	62 degrees Fahr.
November	53 degrees Fahr.
December	46 degrees Fahr.

This gradual lowering of the average daily temperature, as winter approaches, naturally reduces and finally cuts off their food supply (aphids), hunger then sets up certain chemical reactions which cause them to move, thus giving other influences an opportunity to come into play.

A good example of this is afforded by the behavior of young caterpillars, as noted by Loeb: They will follow the light on any substance, as long as hungry, and if no food is found, will keep on climbing, conceivably, until they die. When cold, they will not move; under the influence of heat, they again move and crawl upward, and coming into contact with food, they eat. When fed, they crawl away from the light. When hungry, the light sets up certain chemical reactions, which cause them to move.

In the case of the caterpillars just cited, their movements were governed *phototropically* (by light stimuli).

In the case of the ladybirds, probably *anemotropism* (reaction to the influence of air currents), plays an important part in controlling the direction of their movements, to which they respond negatively.

It is a matter of common knowledge, that strong flying species of *Lepidoptera* are negatively anemotropic, responding to air currents, and thereby being carried up mountain slopes and congregating in large numbers at the summit.

The general topography of the country in question consists of a valley

with a great area, embracing a large number of small valleys which gradually diminish in size, and all finally terminating just below the summit of the Sierra, thus forming, as far as the air currents are concerned, a sort of topographical funnel, and it is at or near the termination of this topographical funnel that the hibernating colonies of *Hippodamia convergens* are located (Fig. 67), and it is in this section that we have been able to yearly collect this species in ton lots.

The meteorological conditions of the particular section under discussion, according to N. R. Taylor of the U. S. Weather Bureau, are such that practically all our winds are westerly winds, blowing directly

FIG. 69.—Part of Fig. 68 enlarged. (Original.)

towards the termination of what we have called a topographical funnel.

Since the *Coccinellida* are negatively anemotropic, they are thus carried with these prevailing air currents into the mountains, and are thereby centered into a small area which constitutes their hibernating quarters.

This process is more or less a gradual one, due to the various experiences of the individuals, and they arrive at the hibernating grounds, one at a time, comparatively speaking.

It must not be inferred from the above, that this hibernating flight is regulated by one influence alone, *i. e.*, the wind, just as the swarming of bees is due solely to the sudden extra development of positive-heliotropism, as demonstrated by Kellogg. It is undoubtedly due also to a

complexity of lesser tropic reactions, such as those produced by hunger, temperature, moisture, etc.

It would be extremely difficult, if not practically impossible, without further experimentation, to authentically analyze these minor reactions.

It is sufficient to state that the beetles finally do reach the locality mentioned, and are to be found in exactly the same precise spots each succeeding year, as can be shown by our card index-locating maps.

Just how they are attracted to these same spots has always been somewhat of a conjecture, and various theories advanced, ranging from inherited memory (extending through the several succeeding generations that issue between the time the brood leave these particular hiber-

FIG. 70.—An example of *Hydrotropism* (moisture). (Original.)

nating spots in the spring, to the time the brood returns to the same hibernating quarters in the fall), to accumulative instinct, without any satisfactory solution.

With regard to our explanation of this particular phase of the behavior, we have attempted to show, step by step, how the *Coccinellidæ* are drawn to this locality, and for the purposes of this article we now have them in the section known as our collecting ground.

Chemotropism now enters strongly as a factor in governing their actions, as they are flying up the canyons over a spot where a colony containing 100 pounds, or approximately 2,742,400 individuals, hibernated the previous winter.

The fact is generally admitted that insects, and especially *Coccinellidæ*, emit a peculiar odor, not necessarily in this case a sex odor, which is only emitted during the breeding season, but probably a recognition or repellent odor, as is evidenced by the fact that the *Coccinellidæ*, though showy and easily recognized, are eaten but by two species of birds, probably on account of this repellent odor or fluid which is emitted, and which, undoubtedly, is distasteful to other species of birds, although this protective fluid, beyond being a sharp acid, is not actually repellent to the human taste, yet differs slightly in four different species that the writer has personally tasted and had under experiment while working along lines of natural and artificial hibernation.

We are wont to judge most things we see by ourselves, and we measure the actions of all other living things from a standpoint of our own understanding, and our interpretations are, therefore, necessarily faulty, and many times absolutely wrong in their entirety, and, therefore, can be but mere guesses or opinions. The sense of taste, which in general is but a chemical effect on the nerves, may affect the nerves of a man in a different way from which it effects another animal.

Also we find many dead beetles in these spots in the spring, which have only had sufficient vitality to reach the hibernating spot, but not enough to withstand the hibernating period. The bodies of these dead individuals retain the odor at least until the immigration in the fall.

We have previously cited cases where insects have responded to stimuli induced by odor at a distance of half a mile; what reaction then must take place when they encounter the odor that still remains in the ground, due to the fact that a colony of the size mentioned had previously hibernated there? The logical conclusion is, that they would immediately react to the stimuli and be drawn directly to the identical spot described. Each individual joining the colony in this manner would increase the volume of odor, and consequently, as the colony increases in size, so would it attract individuals from a greater distance.

This peculiar odor is of such strength that it is also recognized by the writer and his assistants in the locating and collecting work, and many large colonies yielding several hundred pounds have been located and marked absolutely by this means alone, when not a single *Coccinellid* has been visible.

The odor is distinct, but is not displeasing, yet once recognized will always be remembered.

For the sake of brevity, it will be necessary to pass hurriedly over the remaining phases of this subject; the primary object of the article was to explain, in response to repeated requests, why these *Coccinellidæ* congregate in the locality mentioned, in such numbers as to be almost beyond belief; a coincident that in the history of the world has never been paralleled.

To gain some conception of the number of individuals handled by the California State Insectary an illustration (Fig. 65) is presented in connection with this article, showing a consignment ready for shipment in front of the Insectary, containing 28,119,917 individuals.

A combination of this reaction to the odor (*chemotropism*) and reaction to the stimulus of contact with other individuals (*thigmotropism*) holds the beetles in these given spots, and with the arrival of cold weather and snow they become dormant. The warmer temperatures of spring cause them to again become active, and with this returning activity comes fertilization of the species; this activity also sets up hunger, in the same manner that excessive activity or exercise induces hunger in the human body.

It will be remembered that these individuals were drawn to this

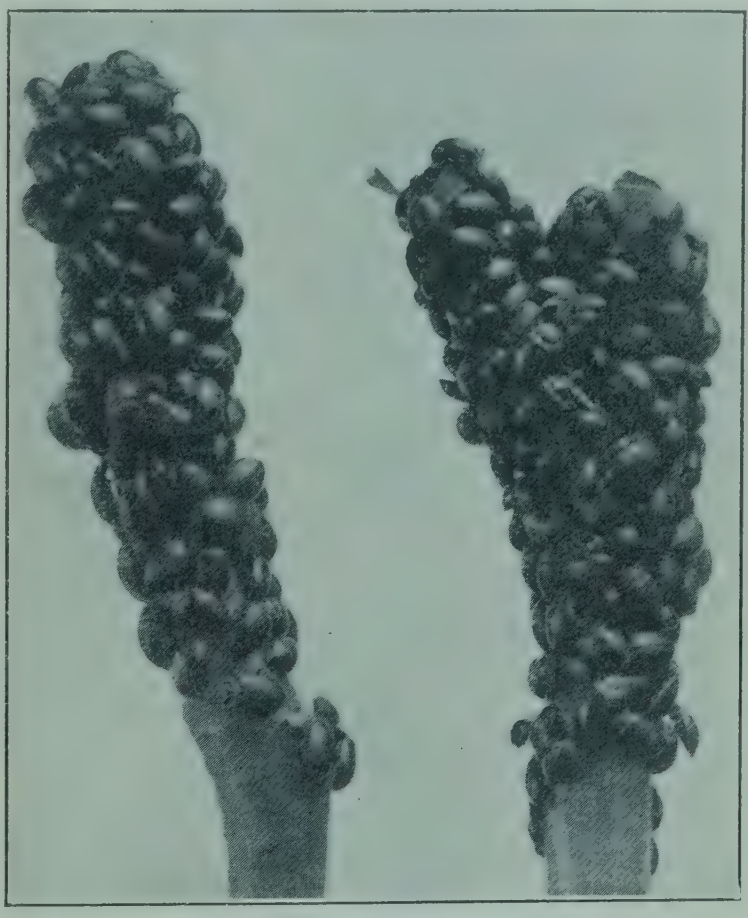

FIG. 71.—An example of *Geotropism* (gravity). (Original.)

locality without previous hibernating experience. The return to the valley is governed somewhat differently, as the beetles are in possession of the individual experience of feeding, and are impelled by a force similar to that which causes the return of the solitary wasp to her nest, concerning which, lack of space will not permit of further discussion. In this connection, the statement that the writer has personally followed the returning flights of this species down the canyons for ten miles, when the air was seemingly filled with swiftly moving beetles, must be sufficient for the present, and while extremely interesting to witness, was very annoying to experience.

The vastness of the subject forbids a more extensive explanation at this time of the various tropic reactions exhibited by this species, which lends itself readily to the study of tropisms.

Photographs are shown of the beetles under various influences, such as light, moisture and temperature; also one showing a typical hibernating locality, with the collector at work.

Special attention is called to the example of response to the stimulus of *Geotropism* (gravity), as portrayed by the illustration presented (Fig. 71).

BLOCK FUMIGATION.

By S. A. Pease,

Horticultural Commissioner of San Bernardino County, San Bernardino, Cal.

By block fumigation is meant the fumigation of each orchard in a given block the same season and at as nearly the same date as possible.

The thrifty orchardist wishes to give his grove the best possible care. He irrigates, cultivates, and fertilizes. But even then his work will not bring the best results unless he keeps his orchard free from scale pests which sap the life of the tree. To actually keep his orchard clean depends not only on his own work, but on his neighbors as well. An ideal law would be one which would give the county commissioner authority to stipulate that a certain remedy should be used when an approved remedy is known and available.

Under old methods, or the go-as-you-please system, such a man might clean his orchard thoroughly, say early in the season, but some of his neighbors for one reason or another would leave theirs until late in the season or possibly postpone it until the next year, thus there is maintained a breeding ground for reinfestation of surrounding orchards.

Under the block system all orchards are disinfected at practically the same time, the work being commenced so as to always proceed with the prevailing wind. This prevents rapid reinfestation as the scale insects' greatest spread is invariably with the wind.

Under our present law this system can not be carried out to bring the best results except by the consent of all concerned. Our law is weak in that it does not give authority to specify the method of disinfection.

One man may object to fumigation as too expensive and resort to spraying or some other equally useless method. Thus, this orchard is a plague spot to his neighbors. Under a specific law as above mentioned the block system would insure uniform work and good results.

A Word About Fumigation.

Too many appear to think that fumigation means to cover the trees with any kind of an old rag, and then place an indiscriminate amount of chemicals under and for any convenient length of time.

Fumigation to be successful must be systematic and follow certain rules. Tents should be made of good, close-woven material and of good strength. When in use they should be gone over each day after they

have been in use and mended. This does not mean to mend some of the larger holes that may be found easily, but mend every hole that admits light when viewed from the under side.

Use only chemically pure cyanide whether potassium cyanide or the sodium cyanide.

Use the marked tents and measure accurately around the tent when over the trees.

Use the Woglum schedule and leave the tents on the trees for forty-five minutes.

NOTES ON CROP STATISTICS.

By G. E. Merrill.

For some time the State Commission of Horticulture has realized that there is an insistent demand for accurate statistics concerning the extent of the various horticultural interests of the State. There is also a demand for timely information on the size and quality of the growing crops. The satisfaction of the latter demand depends plainly, for one thing, on a knowledge of the number of bearing and non-bearing trees and vines in the State, a matter that will be considered in a subsequent issue of the Bulletin. In the present article is given a discussion of the proposed crop estimates and a preliminary report on the crop conditions for 1912, particularly with reference to some deciduous fruits.

Of course, estimates of the different crops are now made yearly by several organizations; for instance, by different members of the agricultural press and by the fruit buyers. But no one of these organizations, unless it be that of the buyers, has for the getting and the dispensing of this information the machinery that lies at the hand of the State Commission through the county horticultural commissioners and their inspectors. Moreover, the information gathered by the buyers is acquired at their expense and is used for their profit. The information obtained by the State Commission will be unprejudiced and will be used primarily for the benefit of the grower. In this connection, it is only fair to state that the doing of good work in a county calls for a considerable outlay of time on the part of the commissioner and his inspectors. The growers then should lose no opportunity to assure their supervisors that they are supporting their commissioner.

Crop Conditions for 1912. An accurate, or even a rough estimate of the actual crop of deciduous fruit is manifestly impossible at this early date. The best we can do now is to acquaint ourselves with the abundance and quality of the bloom, the scope of frost damage and the moisture conditions in various sections. In order to do this, a copy of the following letter was sent to each county horticultural commissioner.

March 21, 1912.

Dear Sir: As you probably already know, the State Commission wishes to gather accurate information relative to the prospective fruit crop in the different counties of the State. To this end we are asking you to report to us, before the end of the month, the present crop conditions in your county. We wish particularly to know how the bloom is appearing on your principal fruit and nut trees, and the extent of frost or

other damage to date. This report does not need to be long; what we want is a brief summary that we can use in the forthcoming issue of the Bulletin. For this purpose your report should be in this office before April 1st. Kindly send it to the Chief Deputy Commissioner, Mr. G. E. Merrill.

As the value of the information desired lies largely in the accuracy and completeness of this report, we earnestly hope that each county will be heard from promptly. We also hope that you will keep this work in mind in the future, as we shall look for monthly reports throughout the growing season.

Trusting we may secure your hearty and active coöperation in this matter, we are

Sincerely yours,

A. J. Cook,
State Commissioner of Horticulture.

To date (March 29) 22 replies have been received. The unusually large number received at this early date indicates a hearty spirit of coöperation on the part of the county horticultural commissioners and we feel sure we shall be able to, through their efforts, secure estimates of the crop that will be second in accuracy to none.

From their replies the following summary for the present crop conditions has been made:

Almonds. The almond bloom was heavy. The set thus far seems to be excellent. Some frost damage has been reported.

Apricots. Varying reports have been received as to the apricot situation. The bloom in many districts was light and considerable frost damage has been reported.

Peaches. The outlook for a good-sized peach crop is encouraging. The bloom is heavy and the set appears to be good.

Plums. In the majority of districts heard from both the bloom and set of shipping plums is good.

In any speculation as to the size of this year's crops, the probable effects of the abnormally dry season should be borne in mind. A large part of the deciduous fruit of the State is produced where there are no facilities for irrigation and the continued dry weather will undoubtedly interfere with the development of the fruit.

THE WALNUT PLANT LOUSE.

(Chromaphis juglandicola (Kalt) Walker).

By E. O. Essig.

The walnut growers in certain sections of California and especially in the southern part of the State, have often been annoyed by the presence of the walnut aphid, which is alarmingly thick some years. This aphid appears in the spring soon after the foliage comes out and at once begins to infest the leaves on the under surfaces. The insect multiplies very rapidly and soon a small colony will number thousands. The following brief and general description will serve to identify the species:

Winged Viviparous Female. (Fig. 72 A.) The first individuals which appear in the spring have very short and indistinct wing pads which soon become full-developed wings, and for a number of months only these winged forms are present. They have the power to produce

young without sexual intercourse, and this is responsible for their ability to increase. The body is very flat, and rests closely to the surface of the leaf. The average length is nearly one eighth of an inch. The prevailing color is from a very light straw to a rich yellow, with dusky markings on the head, usually four dark spots on the abdomen, and the tips

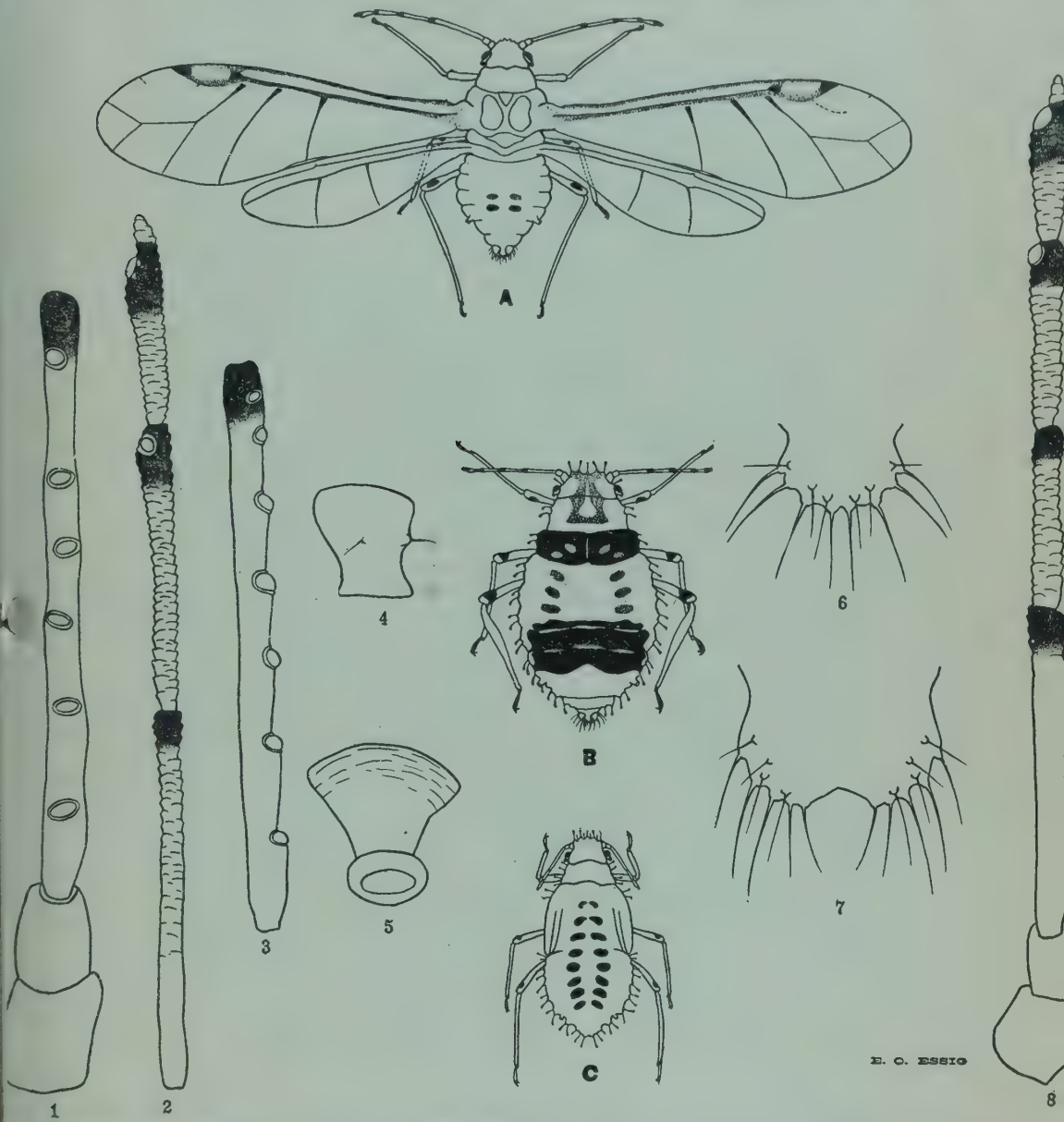

FIG. 72.—Walnut plant louse (*Chromaphis juglandicola* (Kalt) Walker). A. Adult winged viviparous female; B. Adult apterous viviparous female; C. Nymph of winged female; 1-3 Antenna of winged female; 4. Cornicle (honey tube) of winged female; 5. Cornicle of apterous female; 6. Style; 7. Anal plate; 8. Antenna of apterous female. (Original.)

of the antennal articles (except articles I and II) black. The femora (commonly called thighs) of the middle and hind legs, have a black spot near the tips on the upper surfaces. The wings are perfectly clear and transparent, with the veins as shown in the figure.

The young nymphs, which grow to become the winged females, are usually lighter in color, and the body is covered with long knobbed (glandular) hairs. There are, also, usually two rows of black spots, extending down the back. (See Fig 72 C.)

Apterous Viviparous Female. (Fig. 72 B.) During the later summer months of September and October, the wingless viviparous females (having power to produce living young) appear. They are about as long as the winged forms, but somewhat wider. In color they are much darker. The head is dusky, the thorax has a distinct black band running across the middle, and the abdomen has six black spots and a wide black band (may be made up of three narrow bands) on the back—the bands being just in front of the honey tubes. The tips of the antennal articles are dark as shown in Fig. 72, 8. All of the femora have the black spot near the tips. Like the young nymphs, the bodies of this form are covered with the long knobbed, or gladular hairs or spines.

This species is a remarkable producer of honey dew, which soon completely covers the foliage of the infested trees. Upon the honey dew collects the dust of the roads and there grows a black fungus which gives the trees the black and smutty appearance. The extent of any infestation can easily be told by the color of the foliage on the trees, and no careful examination is necessary to find the lice.

Control.

Fortunately this is one of the injurious insects which is held in almost perfect check by a natural enemy. If it were not so the walnut orchards would suffer damages similar to those of the apple and peach orchards, because of other species of aphids, which are not so held in check by nature. The value of such control is great when we consider the difficulty in spraying such large trees.

The natural enemy of this aphid is a predaceous ladybird beetle, commonly called the ashy-gray ladybird beetle (*Coccinella abdominalis* Say) all stages of which are shown in Fig. 73. The eggs of this beetle are deposited by the females as soon as the aphids begin to appear and care is taken to place them where the young larvæ will be able to find food close at hand. They are orange to yellow in color, and laid in clusters, not unlike bunches of small cigars stood on the sharp ends. The young hatching from these eggs are first dark, but soon show bright yellow markings along the sides and on the backs. They are very active, and when full grown are nearly three fourths of an inch in length. This is the stage in the life history, which is most valuable in the destruction of the plant lice. In order to complete their growths and transformations, these little fellows must devour great quantities of food, and they certainly do. Every larva will destroy dozens of plant lice daily for several weeks, and then it is ready to transform.

To do this the larva attaches itself by the tail end to a limb, or to some convenient sheltered place, hangs with its head downward, and soon becomes a pupa. This is the resting and transforming stage from the young to the adult beetle, and is not very well known to orchardists.

Some have destroyed these pupæ, which they thought to be some kind of a borer, in the act of killing their walnut trees. I know of just such a case.

From the pupa develops the adult beetle, which varies from a straw-yellow to an ash-gray color, and is covered with numerous black spots, as shown in the photograph (Fig. 73).

I have made a close study of the habits and distribution of this louse

FIG. 73.—Ashy-gray ladybird beetle (*Coccinella abdominalis* Say), showing eggs at top, adults at right-hand middle, pupa at left-hand middle, larvæ at the bottom. (Original in P. C. Jr. Ent.)

in the walnut orchards of southern California through a period of four years, and find that, though it often appears in great numbers during the early spring season and does considerable damage, it is always finally controlled by the ashy-gray beetle before any very great amount of harm is done, and at a much lower cost than by artificial means of control. Other ladybird beetles, the green lace wing (*Chrysopa californica* Coq.), and perhaps internal parasites, have a hand in this work.

but taking them all together, they can not begin to do what the ashy-gray does. Last year, through Mr. E. K. Carnes, Superintendent State Insectary, I was able to procure great quantities of the red ladybird beetles (*Hippodamia convergens* and *Coccinella californica*) and liberated them in the walnut orchards. It was noticeable that in a day or so scarcely one of these were to be found in the original places—they had wandered to more suitable feeding grounds, while the gray beetles remained established in the orchards throughout the entire season. It will pay to introduce this latter beetle into any locality where the walnut louse has become a menace, and where the ashy-gray is not already established.

GENERAL NOTES.

A SERIOUS FORAGE CROP PEST.

Recently we received from near Freeport, Sacramento County, some larvæ or maggots that were extremely abundant in pasture land, and had also been found in alfalfa. They are the larvæ or young of a cranefly. This fly is sometimes called "daddy-long-legs," or "mosquito-catcher." We have reared adults, and Professor Doane, of Stanford University, has identified these as *Tipula simplex*, a species which is found in various parts of the State, and which often becomes so abundant that its larvæ cause serious damage in pasture lands. Now comes the report that they have been found in alfalfa and also to some extent in barley and oats. The larvæ or maggots live just beneath the surface of the ground, and feed on the roots of these plants. We are told, however, that they are able to do little damage to old alfalfa, owing probably to the toughness of its roots. Nothing has been suggested in the way of a remedy, except a free use of lime or ashes, and it is not known that these are effective. It would be difficult to apply anything to pasture lands that would be cheap enough to be practicable. We are working on the life-history of this species, and hope to publish in the near future a more detailed account of it, together with something more in reference to control, as it is becoming a serious pest in some localities.—E. J. NEWCOMER.

THE FLAT-HEADED APPLE-TREE BORER.

If the number of inquiries received at this office is a safe criterion, then the flat-headed apple-tree borer (*Chrysobothris femorata*, Fabr.) is one of the most common insect pests of our northern California orchards. Though usually known as the flat-headed apple-tree borer, it works on other deciduous fruit trees, quite often on peaches, and is even found on oaks. I have known it to do great damage on apricots in northwestern Los Angeles county. It is abundant East, and probably exists the country over.

Life History.

The imago, mature, or adult beetle is about one half an inch long; gray, flecked with black, with bronze or greenish reflections; the legs and under side copper colored. It is rough, oval, flat, with the head deeply sunken into the thorax. In the East, the beetles may be seen on the south and southwest sides of the trees, enjoying the warm sunshine in June and July. They lay their eggs at this time, on the southwest side of the trees, possibly because the trees are usually blistered and rough on that side. The eggs soon hatch, and the grubs eat into the tree, burrowing just beneath the bark in the cambium layer. The bark at this place becomes dark, nearly black, and a sharp pointed knife blade,

because of the burrow, pushes easily through the bark. In the burrows will be found frass and the sawdust-like chips. The joints of the thorax back of the rather small head of the grubs are much broadened and flattened, so we have the term "flat-headed borer." All of the larvæ of this family, *Buprestida*, have this peculiarity. The six legs are very minute and scarcely visible. When the grub attains its full size it is fully one half inch long, and when taken in its burrow is usually curled up. It passes through its life cycle in a year, and so will be found as a grub or larva from May or June until late in the next spring, when the pupa, much resembling the adult beetle, will be found in the tunnel formed by the grub.

This borer need not be confused with the peach borer (*Sanninoidea opalescens*). That is a caterpillar with sixteen legs. This is a grub with six very minute legs, scarcely visible. That works nearly always at the crown of the tree, just beneath the earth. This works almost always on the trunks above ground. That gouges out a large, ugly gash on all stone fruit trees. This destroys the cambium layer of apple, peach and other trees. That attacks sound and feeble trees alike, is no respecter of trees as to their vigor. This rarely attacks vigorous trees. The big-headed borer is specially likely to attack newly set trees, as they are very likely to have their vitality impaired by being transplanted. The location of these borers on the southwest side of the tree is likely gauged from the same fact.

There are three suggestions regarding the control of this pestiferous borer. First, if we take great pains to maintain the trees in full vigor, we shall suffer much less from the ravages of this *Buprestid*. Second, if we shade the trees from the hot sun, the blistering effect of the heat rays will be prevented, egg-laying lessened and damage checked. Third, if we rub the tree trunks in May, especially trees newly set from the nursery, with a cloth or the gloved hand, after dipping the latter in a strong solution of soap, or better, of soft soap, we will almost surely save all our trees from attack. One year I set about my farm in Michigan one hundred maple and other shade trees. A friend set the same number on the very same day. I used the soft soap freely each spring for the next two years; he did nothing. At the lapse of two years I had lost one tree, broken down by a careless driver; he had one tree remaining as the borers had ruined all the others. One year I set several apple trees on my yard in the campus of the Michigan Agricultural College. My colleague, Dr. W. J. Beal, did the same, at his place only a short distance away. I used soft soap freely for two seasons; he left his trees severely alone. My trees are all living and bearing luscious fruit to-day; his were all sacrificed years ago to the greed of these voracious borers.

The nurserymen are rarely ever to be blamed for the presence of these flat-headed borers, as the eggs are not usually laid till after the trees have been planted. It would, however, be very wise for the nurserymen to suggest the remedies already given above whenever they sell a bill of trees to a prospective orchardist.—A. J. Cook.

DISTRIBUTION OF NOVIUS (VEDALIA) CARDINALIS, NATURAL ENEMY OF COTTONY CUSHION SCALE (Icerya purchasi).

At this season of the year numerous applications for colonies of *Novius (Vedalia) cardinalis* are received at the State Insectary accompanied by urgent requests that the *Vedalia* be sent immediately as the cottony cushion scale has just appeared in the orchard.

This is, usually, not correct, as the scale has probably been in the orchard all winter in the half-grown stage, in which form the white carinated egg-sac is not present, thus rendering the insect somewhat inconspicuous and more easily escaping detection.

With the development of the white egg-sac, this scale insect (Fig. 74) is easily noticed, which prompts the general belief that they have just appeared.

This once serious pest, now completely controlled by its natural enemy, still strikes terror in the minds of many of our growers, who become greatly alarmed at the first indication of its presence on their trees, no doubt remembering the great havoc it once wrought to the citrus industry in this State; and I sometimes wonder if our growers are aware of what would happen if some secondary parasite should gain admission that would destroy the *Novius (Vedalia) cardinalis,* as effectually as the *Vedalia* destroys the cottony cushion scale.

In the progress of our successes, and with minds full of progressive plans for the future, we are wont to forget, or to underestimate, the true value of present and past achievements, which are in reality the real foundation of our present prosper-

FIG. 74.—Cottony cushion or fluted scale (*Icerya purchasi*). (Cal. Hort. Com.)

ity: All of which has a bearing on the following request, i. e., when making application for colonies of *Novius (Vedalia) cardinalis*, or when commissioners or inspectors refer applicants to the State Insectary for colonies, do not forget to send, or ask those inquiring to send, by express at our expense, a box of infested twigs or branches to use as food in our breeding cages.

It is a difficult task for us to raise *Icerya purchasi*, in sufficient quantity, and greater still to keep the *Vedalia* from the trees and plants so stocked, in order that we may propmtly fill all applications for this valuable coccinellid.

If each applicant will send us a box of infested branches by express, at any time, and especially so when making application, or whenever a commissioner or inspector comes across a lot, it will be of the greatest assistance to the State Insectary, and will insure the prompt filling of your order. Address all packages to the State Insectary, (E. K. Carnes, Superintendent), Capitol Park, Sacramento, California.—E. K. Carnes.

CROWN GALL.

How to treat crown gall has been a puzzling problem. The nurserymen, even the National Association of Nurserymen, have declared it to be non-contagious, but now all doubts are removed, and crown gall is ever after to be rejected. Mr. Hedgecock, of the United States Department of Agriculture, has made a prolonged study of this malady, and has performed numerous experiments over a series of years. He declares that the various varieties of this disease; hard gall, soft gall, gall of raspberries and blackberries, of the peach and the apple, of hairy root galls, are all virtually varying forms of one and the same ailment. Though the disease varies in different plants, and at different stages of development, yet in all cases it is of the same character, produced by the same cause and always somewhat contagious. Hence, under no condition, should trees or shrubs bearing this crown gall be allowed to go into the trade. Like nearly all bacterial contagious affections, the only safe way to treat it is to absolutely bar its entrance to our orchards or nurseries. Only yesterday I received from one of our county commissioners a grape vine horribly deformed by this crown gall. He said that a nurseryman had removed from several hundred such vines the excrescences and had then grafted on the lower crown, scions from other vines, and asked if this was wise action. It would be almost certain that the plants would be inoculated through the sap, and I should regard such vines as absolutely unsafe.—A. J. Cook.

QUARANTINE WORK IN SOUTHERN CALIFORNIA.

The prevailing dry weather during the month of February does not appear to have affected in any way the volume of horticultural imports into the southern metropolis and its environs. The record for that month shows that 3,228 packages were intercepted and inspected by the quarantine officers stationed at Los Angeles and San Pedro, and 919 by the inspector at the port of San Diego. These came from practically all quarters of the globe, and by all the different avenues open to modern transportation, even the United States mail. The work of handling this large amount of material now proceeds smoothly, and with as much celerity as safety to the horticultural interests of the State will permit. This is due in a large measure to the system that has been established, and to the harmonious coöperation between the agents of the transportation companies and the quarantine officers.

The material comprising these imports has been, as a general rule, clean and of a desirable character; however, some shipments have been found infested with live insect pests of such a nature as to compel their destruction, and others again infected with diseases that have necessitated their reshipment out of the State. Plants, and fruit with foliage attached, infested with live *Aleyrodes citri,* have been met with in so many instances as to become a commonplace occurrence, and even the egg-masses of the gypsy moth have been discovered on imported trees since the last report was published. The eelworm has been located in potatoes grown in at least three localities in Los Angeles County and in the roots of fig trees from still another one. At the time of this writing the entire force of the division is rejoicing in the fact that so far no alfalfa hay has been received from the State of Utah, and consequently the advent of the alfalfa weevil into our hay fields has been correspondingly postponed. Four hundred and sixteen sacks of alfalfa seed from Utah have arrived during the season, but these were subjected to the closest of scrutiny and the severest of disinfection, so that no apprehension need be entertained in regard to their admission. The much dreaded plant material from France has arrived, been inspected and released. It is but fair to state that this material was by far the best, in point of cleanliness and quality of packing material, of any that has passed through our hands this season, and shows very clearly that the admonition received from some source of great weight had been carefully heeded by these shippers.

In relation to the foregoing matter, the writer, anticipating the possibility of brown-tail moth accompanying these shipments, and realizing that none of the local quarantine officers had ever had the opportunity of seeing either this scourge or its congener, the gypsy moth, wrote to the chief of the Bureau of Entomology and requested museum specimens to be used for educational purposes. The response of Dr. L. O. Howard was as prompt as his interest is wide in all matters pertaining to the protection and economy of crop production, and he sent to the southern

California office a superb collection of specimens of each life stage of both the gypsy and brown-tail moths. These, in a suitable manner, I arranged in two groups and brought the exhibit to the attention of the inspectors. If the good Doctor could have been present and seen the interest and heard the pertinent questions of these bright-eyed young men as they studied the different features of this exhibit, I believe he would have felt amply rewarded for his generous action in this matter, and I desire both on the part of these young men and also myself to herewith record my sincere thanks for this valuable assistance graciously rendered by Dr. L. O. Howard to the horticultural quarantine service of the State of California.—FREDERICK MASKEW.

TWO EXCELLENT BULLETINS.

I have already commented on the two admirable bulletins, No. 214 and No. 223 (see Monthly Bulletin, Vol. 1, No. 2, page 63, and Vol. 1, No. 3, page 106). Bulletin 222, by the same author, Prof. H. J. Quayle, was issued previous to No. 223, and like the other is surely a credit to the author and to our University. Like the treatise on black scale (*Saisettia oleæ*), so this bulletin on red scale (*Chrysomphalus aurantii*) is a very complete monograph, and one finds little or nothing to criticise. In my former reviews I may have done Professor Quayle injustice, and if so, I hasten to make amends. He does not say that the black scale only injures by attracting the black fungus, or causing the damaging smut, but he thinks that the paramount cause of the injury, and gives reasons for his contention. He does not say that the red scale works only on the citrus trees, but he gives reasons for his opinion that it does little harm to other plants which it infests. I have sometimes wondered if the toxin idea is more than theory; as I have always felt to doubt Professor Whitney's theory of soil poisoning. Yet here the red blight on trees attacked by the San José scale (*Aspidiotus perniciosus*) would seem to give some credence to the theory of toxin poisoning.

Bulletin No. 226 treats of the purple scale (*Lepidosaphes beckii*). Were this as widely distributed it would be the most damaging of all scale insects. It blights the tree, disfigures the fruit, and is very hard to kill. This treatise, like the others, is very complete, and until more is known regarding it, will, like the others, suffice to satisfy alike student and practical man. These two bulletins, as is true of the other two, can be had for the asking of the University at Berkeley and should be among the possessions of every county commissioner and inspector.—A. J. COOK.

NOTES FROM THE COUNTY COMMISSIONERS.

By G. E. Merrill.

Butte. Mr. Mills has inaugurated a yellow scale clean-up campaign for the cities of Chico and Oroville.

Inyo. A. R. Baird, formerly of College City, Colusa County, has been appointed county horticultural commissioner.

Lake. Mr. Lyons has been making a vigorous fight against the pear blight in Lake County nurseries.

Napa. The pear thrips were probably more abundant this year than last. Their attacks seemed to be particularly severe in newly infested districts.

Nevada. Mr. Bree is vigorously prosecuting a systematic clean-up campaign against the various pests in his county. He is paying particular attention to insect pests on residence property in towns and cities.

Sacramento. The pear thrips were markedly fewer in number this year than last. This condition no doubt is due in part at least to the vigorous fight made against the pest during the past two years.

Santa Barbara. Mr. Beers informs us that he has secured the Assembly Hall in the Hotel Potter for the use of the Fruit Growers' Convention in June. Mr. Beers has made strenuous and commendable efforts for the success of this convention.

Santa Clara. We are in receipt of University of California Bulletin 228, "New Control Methods for the Pear Thrips and Peach Tree Borer," by County Commissioner Morris. We commend this bulletin to fruit growers and others as a brief, well written account of the results of Mr. Morris' work on these two pests.

Solano. Mr. McBride has recently purchased a Bausch & Lomb microscope for the use of his office. He reports that the attacks of the pear thrips were very severe in new infestations.

Sutter. Mr. Stabler is enforcing the law in an attempt to eradicate the pear blight in the orchards of Sutter County.

Yolo. Mr. Hecke and his inspectors have recently completed an accurate orchard census of Yolo County.

THE POTATO TUBER MOTH.

(Phthorimaea operculella Zeller.)

ORDER—Lepidoptera. FAMILY—Gelechiidae.

1874. *Lita solanella* Boisd.

By E. O. Essig.

History and Distribution in California.

The larvæ of this potato moth were first discovered in California by Mr. W. A. Webster, who sent infested potatoes to the U. S. Department of Agriculture from Bakersfield, Kern County, California, during the first part of November, 1891.[1] During the next year Mr. Koebele found the larvæ in boiled potatoes at Alameda and upon further investigation he found uncooked potatoes infested with living specimens from which were bred all stages of the insect.[2] Mr. Webster believed that the insect was introduced from China, as the potatoes which were infested at Bakersfield were obtained from a Chinese gardener, who likely imported the seed from his native land. It is also supposed that the moth came from New Zealand. Since the insect is distributed over many countries of the world, it is not unlikely that specimens may have been imported from several different localities. At any rate, it became established in our state before a strict quarantine was maintained at San Francisco.

It was very early found to be a serious pest in foreign countries, and as soon as it was known to have been imported into California, active steps were taken by the U. S. Department of Agriculture to work up sentiment enough to eradicate it, but nothing was ever done by the authorities of the state and the pest has been allowed to spread at will.

The insect now occurs practically throughout the territory south of Sacramento, along the coast, and in the interior valleys. It has been reported as occurring at Santa Monica, Los Angeles, Bakersfield, Alameda, and in the Salinas, San Joaquin and lower Sacramento valleys. I have taken it in large numbers throughout Ventura County. It has been known as *Gelechia operculella* Zeller.

Work.

The larvæ of the moth mines the leaves, stems, and tubers of potatoes. In the fields, especially while the vines are still green and growing, they work mostly within the leaves and stems. The greatest damage is done to the tubers usually just before or after they have been dug. In a coarse, cloddy soil, the adult moths have access directly to the potatoes and deposit their eggs upon them before they are dug. Exposed potatoes are also attacked in this way. As most of the work is done at night, it is important that no potatoes should remain exposed after digging except during the daytime.

As soon as the larvæ are hatched from the eggs they immediately bore into the tubers, leaving a small amount of frass around the entrance, over

[1] Insect Life, VI, pp. 234-242.
[2] Rep. Secy. U. S. Dept. Agricl., 1892, p. 156.

the mouth of which they usually spin a fine web. The entrance is nearly always made at an eye or through an abrasion of the skin. The burrows are made indiscriminately throughout the tubers, but at first more often traverse just beneath the skin (Fig. 76). Later they are tunneled throughout every portion of the potato, completely destroying it and

FIG. 76.—Cross-section of potato showing tunnels just under the skin made by the tuber moth (*Phthorimaea operculella*). This is but a mild infestation. (Original.)

causing decay (Fig. 77). The burrows are round and often lined with a thin web spun by the larvæ, which probably serves to keep out the liquids of the tubers, as many of the burrows are dry even in completely soft and decayed specimens.

It is some time before the outside of the potatoes shows any affection by this moth. The first evidence is the shrinking of the small, narrow

areas of skin just above the burrows (Fig. 75) which increase rapidly in numbers as is shown in the photograph. Thus it is possible to locate from the outside all the burrows which are just under the skin. It is not an uncommon thing to find stored potatoes shriveled and roughened almost beyond recognition by the countless numbers of these burrows. After long periods of storage the potatoes not only assume a roughened and shriveled appearance, but they become covered with numerous small piles of excrement which are forced from the burrows of the larvæ (Fig. 77). I have seen whole sacks of potatoes thus completely ruined.

The inside appearance of the potatoes (Fig. 78) is more repulsive than the outside, due to the countless numbers of burrows which soon darken or even blacken the surrounding tissues. Decay and mildew also follow, causing complete decomposition. In the worst infestations the burrows intermingle so as to cover practically every portion of the inside tissues, thus leaving only excrement and destruction behind.

As many as fifty to one hundred larvæ have been taken from a single tuber at a time, and countless millions may be reared from a storage bin.

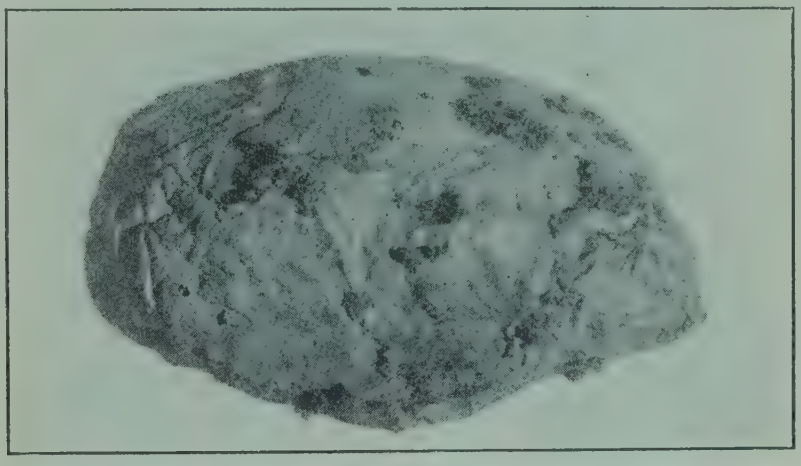

FIG. 77.—Potato entirely destroyed by the larvæ of the tuber moth (*Phthorimaea operculella*). The small piles of excrement or frass were forced from the burrows. In stored potatoes it is not uncommon to find large numbers thus affected. (Original.)

Destructiveness.

The potato tuber moth is classed by many foreign countries as one of the most dangerous pests known, and is considered almost as severe as we regard the Mediterranean fruit fly. Some countries have stringent quarantine regulations regarding it. Such actions are not unwarranted when we consider some of the damages caused by the moth. Thus in Algeria,[1] three fourths of the potato crop were completely destroyed in one year. Thousands of tons were destroyed at Adelaide,[1] South Australia, during the year 1882. The moth is still a serious pest in various parts of Australia, Tasmania, New Zealand, India, China, Southern Africa, Jamaica and Algeria.

[1]Rep. Secy. U. S. Dept. Agric., 1892, p. 157.

It has not caused such destruction in California, but might well be considered a serious pest. County commissioners should be on the lookout to prevent its spread by keeping out infested tubers. To my mind it is far more serious than is the potato eelworm (*Heterodera radicicola*).

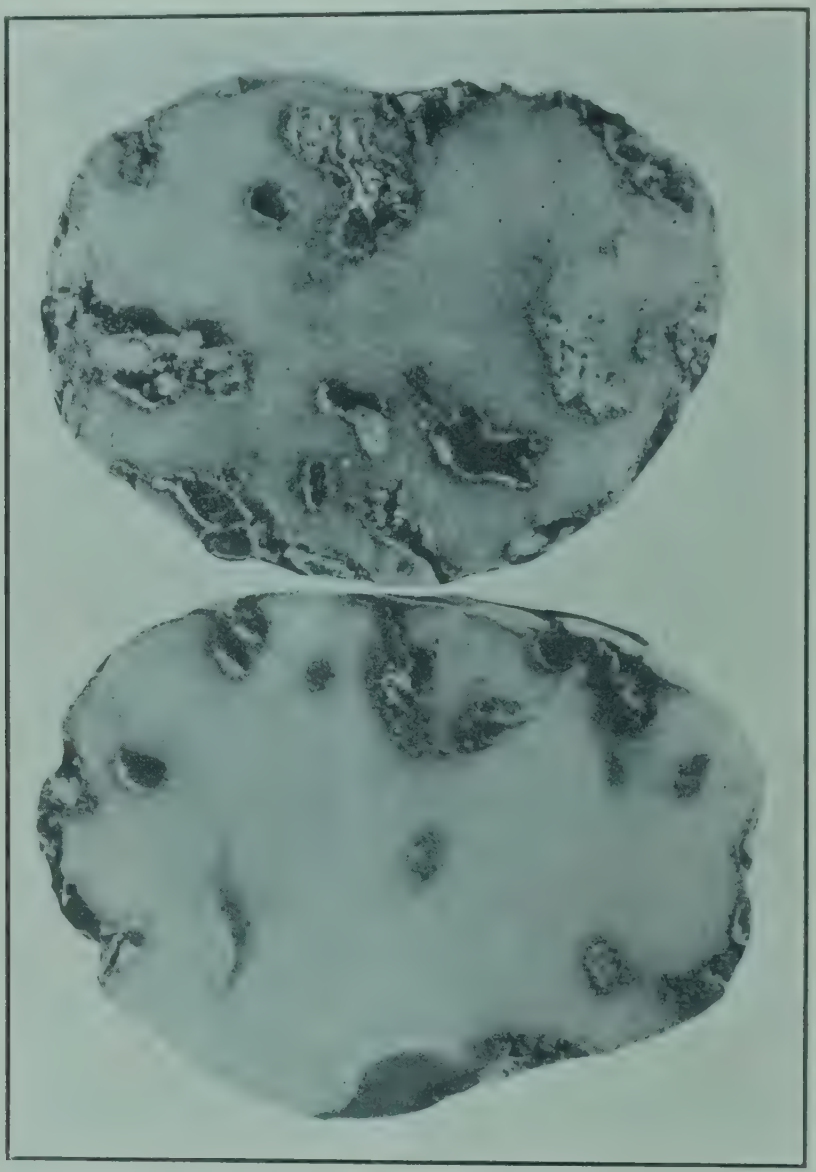

FIG. 78.—Cross-section of a potato to show work of the tuber moth (*Phthorimaea operculella*). Many of the tunnels are filled with frass. This potato was still sound when photographed, though it contained at least twelve larvæ. (Original.)

Description and Life History.

Eggs (Fig. 79).

The eggs are pearly white, regularly oblong or oval in shape and very minute, being scarcely half as large as a common pin-head. They are laid singly or in small and rather large clusters, usually in a sheltered

or protected place. Some writers have described the eggs as being flattened. This is probably because those described were lying on their

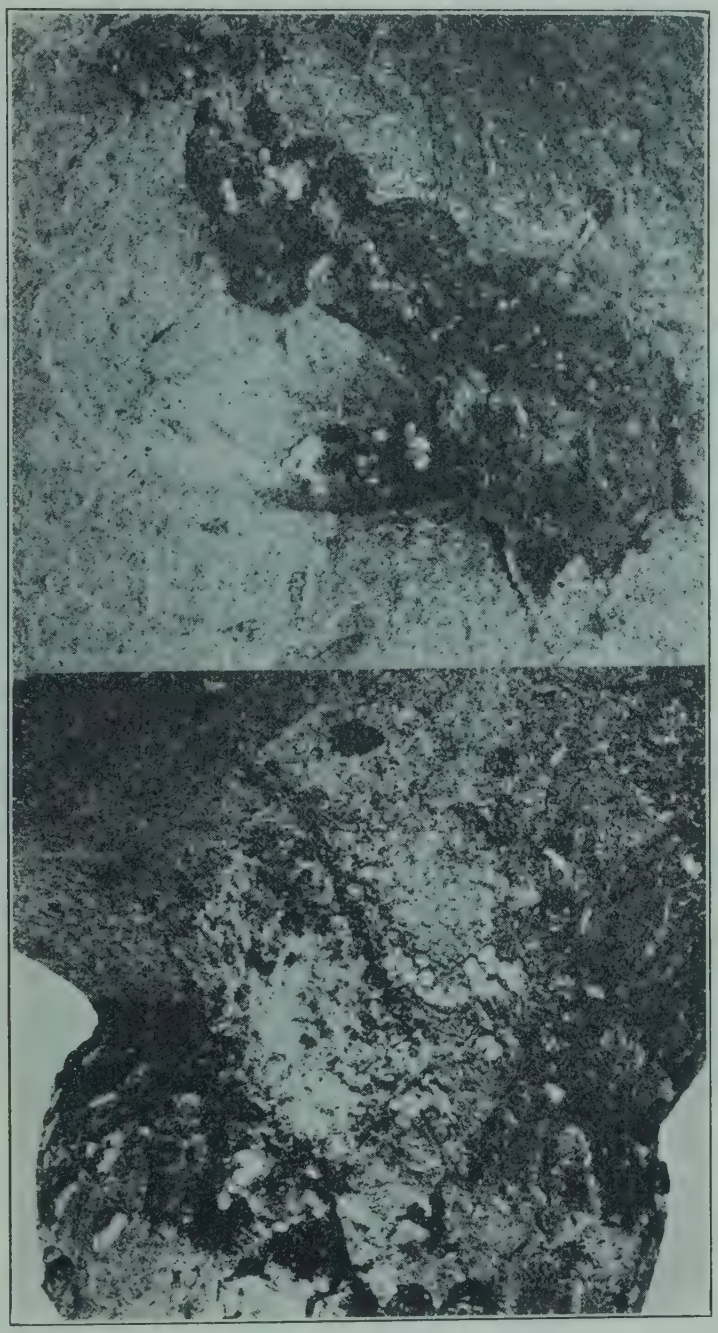

FIG. 79.—Eggs of the potato tuber moth (*Phthorimaea operculella*) laid on the tubers. In the upper picture the small, white, pearly eggs are laid in the eye of the potato and in the cracks caused by potato scab. In the lower picture the eggs are in large clusters on either side of a cocoon, which is covered with frass. Many of these eggs are on their sides instead of being attached by one end. (Original.)

sides rather than suspended by the end as is usually the case. Each egg is fastened by a web which is also loosely woven over and around it, making it firm in position. Many of the eggs appear to be distorted

and irregular, but most of them are perfect in shape. Eggs deposited in a crack in the skin or deep in the eyes of the potatoes appear flattened because the lower half is not exposed to view.

In the field the eggs are deposited on the stems of the vines near the ground or even under the surface. They have also been found on the leaves. In rough ground where there is access between the clods or where potatoes are exposed, they are laid directly on the tubers, preferably around the eyes.

Eggs are also laid on freshly dug potatoes which are allowed to lay exposed in the field for any length of time.

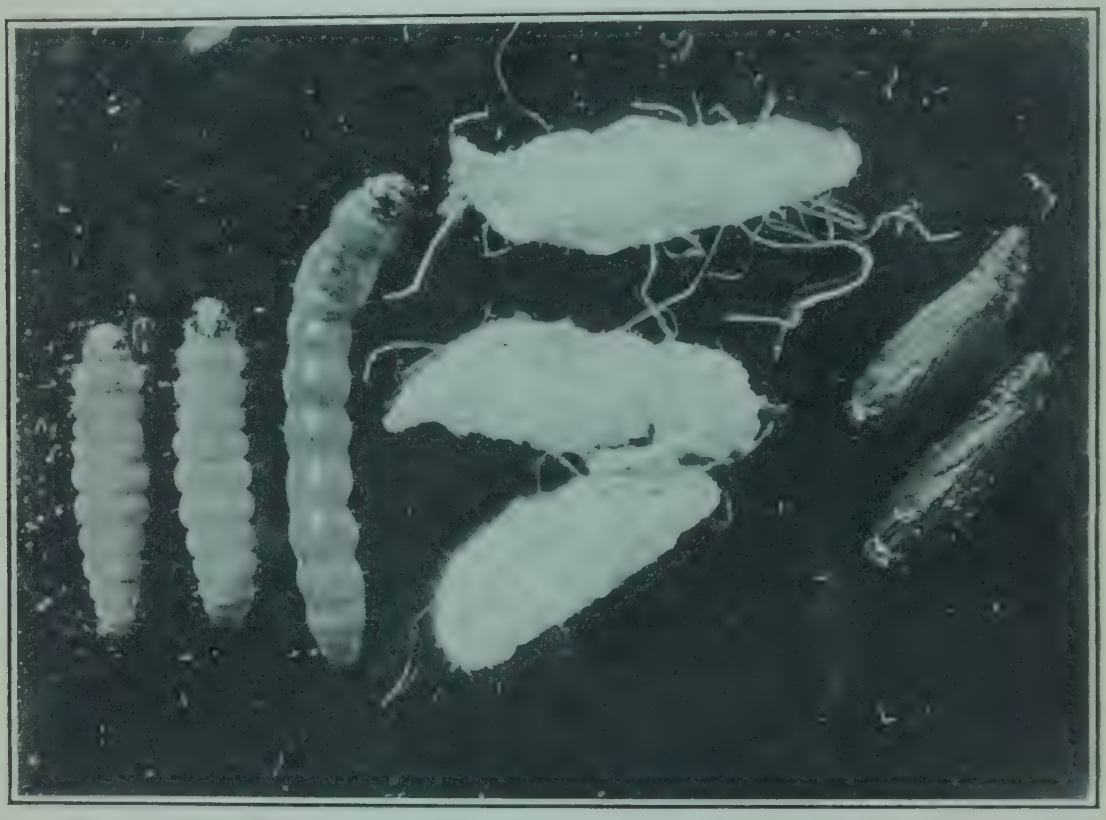

FIG. 80.—Potato tuber moth (*Phthorimaea operculella* Zeller). Larvæ on the left, cocoons containing chrysalids in the middle and the bare chrysalids on the right. Enlarged. (Original.)

In the sacks and bins the eggs are laid in the cracks or abrasions of the skin or in the eyes of the tubers. The rough patches produced by scab afford excellent shelters for them. They are also deposited within the entrances of old burrows made by the larvæ, and around the cocoons of the chrysalids.

The eggs are not always hid, but may be deposited singly upon the smooth surfaces of tubers. This often occurs in storage bins.

It usually requires from seven to fourteen days for the eggs to hatch, though some require even longer, depending upon the warmth of the weather. Each female lays from 20 to 140 eggs, practically all of which are fertile and hatch.

Larva (Fig. 80).

Upon first hatching the larva is extremely small, light in color with a noticeably black head. When full grown it averages three fourths of an inch or a little over in length. The color varies from white, dusky white to a decided pink. The head, cervical plate and thoracic legs are always black, while the face may be brownish. The cervical plate (which is just back of the head) has a longitudinal pale median line. The two body lobes or segments just behind the cervical plate are much darker than the other segments dorsally, but are of the same color ventrally. The extreme posterior or anal legs are light with dark tips. The body is covered with indistinct light hairs or spines. As soon as hatched, the larva immediately begins to find a suitable place to bore into the vine or tuber. Any place where the skin is broken is preferred. If there are no such places the eyes, especially if there are any sprouts appearing, afford an excellent place of entrance, as the skin is very thin there. In the field the larva works upon the stems, leaves and tubers, while in the storehouse, bins and sacks, it works only upon the tubers or on any of the sprouts which may be produced late in the season. When disturbed the larva wriggles so violently as to throw itself for a considerable distance. This no doubt aids it in escaping foes. It requires from three to five weeks to mature, and all that time is spent in feeding.

Pupa (Figs. 80 and 81).

As soon as the larva is full grown it seeks a suitable place for transforming or pupating. Such a place may be near the entrance of an old burrow, in the tuber or stem of the plant, in a mass of dead leaves, under or in a cleft of a dry clod of earth, in the cracks of the bins, on the sides of the sacks or on the smooth or rough surface of a tuber (Fig. 81). Here the larva usually spins a white silken cocoon (Fig. 80) which completely envelops it, and is hardly one inch long. This cocoon is thinnest at the place of attachment, and may be simply a tent-like covering. It is usually covered with the frass from the burrows and other refuse matter so as to appear dark or dirty brown, or even black.

Not all of the larvæ spin true cocoons. This is especially true of those which transform in the old burrows. Here they simply line the walls with a very fine, scarcely visible web, which often appears to be wanting. The pupa proper or chrysalis (Fig. 80) is scarcely more than three eighths of an inch long and varies in color from a light tan to a dark reddish-brown.

It requires about three days for the larva to spin a cocoon. The period of transformation, from the time the larva begins to spin the cocoon until the adult emerges, covers from 14 to 20 days.

Adults (Fig. 82).

The adult female insect is seldom more than three eighths of an inch long, while the male is considerably smaller.

Both are decidedly gray in color with silvery bodies. This gray color is produced by a mixing or mingling of dark, light and faint brick-colored

blotches, all of which vary greatly in size. There is a noticeable black area near the middle of the back of the females and a darker fringe at the tips of the primary wings of the males.

The general color of the males is a little lighter than that of the females, and the spots are more pronounced, though it is difficult to readily distinguished between them except for the difference in size.

FIG. 81.—*Phthorimaea operculella*, showing cocoon on the surface of a potato. This cocoon was fastened between two tubers and when one was removed the chrysalis was exposed. The excrement is plainly visible around the sides. The picture also shows that the cocoon is considerably larger than the chrysalis. (Original.)

Both the males and females are extremely active on their feet and dart among the clods and tubers with great rapidity. They fly readily when disturbed.

The moth is a night flyer, and the eggs are usually laid at that time, so in infested areas it is never advisable to allow potatoes to lay exposed in the field over night.

Host Plants.

The potato tuber moth attacks a great many of the solanaceous plants including the potato, tobacco, "Sodom Apple" and nightshades. In New Zealand the larva also mines within the stems and larger leaves of the common "Cat-tails" (*Typha angustifolia*) which are abundant throughout this State. I have never examined these for the moth, so do not know if they afford breeding places here or not.

Control.

With a full knowledge of the life history and habits of this moth, control methods are not as difficult as might at first appear. The most important factors in control are to prevent access of the moth to the tubers and to destroy eggs and larvæ immediately after infestation takes place to prevent further injury.

Quarantine.

Preventive measures are always best if they are adopted before the moth is once established within a potato-growing section.

Farmers should always examine the seed very carefully and be sure that no infested tubers are planted. This is very important, for if the moth is once established in the field it will be difficult to prevent all infestation of potatoes in the fall. The fact that potato tubers are comparatively free from insect attacks makes the detection of this pest easy.

Never bury or throw infested potatoes on a rubbish pile, but burn if the potatoes are to be destroyed. In case they are to be used for hog feed, boil them or soak in water for several days.

Clean culture.

All weeds and especially those included in the list of host plants should be kept from growing in or around potato fields. The nightshade is a common host plant in California.

Planting and hilling.

A fine sandy loam is the most desirabe soil to prevent infestations of this moth. The potatoes should be planted fairly deep so that no tubers will be exposed when matured, making hilling an easy matter. The hilling should be commenced as soon as the tubers are formed, and if they are not all well covered a second hilling should follow to insure this.

Rough, cloddy or heavy soils do not permit of such ready control, for in them it is almost impossible to keep the moths from the tubers.

Burning tops.

Where the potatoes are well hilled most of the first larvæ appear in the stems or tops, and it is some time before they work their way down to the tubers. It is therefore sometimes advisable to harrow off the tops and burn them before digging the old crop. This is to prevent further infestation.

Spraying as a preventive.[1]

Some foreign authorities advocate spraying with a tar water as a preventive, before infestation takes place. This spray is prepared as follows: Coal-tar, ½ pound; water to mix, 1 gallon. Dilute to make 50 gallons spraying material.

The one half pound of coal-tar is thoroughly boiled in the gallon of water for twenty to thirty minutes before it is diluted.

Lime.

[2]Air-slaked or gas lime at the rate of 30 bushels per acre is beneficial in preventing attacks, and when sprinkled in pits prevents infestation.

FIG. 82.—Adults of the potato tuber moth (*Phthorimaea operculella*) enlarged several times. (Original.)

Digging.

The potatoes should be dug just as soon as they are ripe enough and gotten into the sacks as soon after they are taken out of the ground as possible. Under no conditions should they be allowed to remain in the field either in sacks or on the surface of the ground over night, unless the sacks are securely tied and there is no intention of storing the potatoes in them.

Soaking tubers in water.

All of the larvæ and eggs may be destroyed by soaking the infested tubers in cold water for at least thirty-six hours. This method has been practiced both in foreign countries and in this State with good results.

[1]Bulletin No. 7, New Zealand Dept. of Agric., p. 35.
[2]Handbook of the Destructive Insects of Victoria, pp. 152-153.

Carbon Bisulfid.

In storage bins use from 1½ to 2 pounds of carbon bisulfid to every 1,000 cubic feet of air space. Repeat as often as the adult moths begin to appear. Usually 4 or 5 treatments are required.

Volck on control methods.

W. H. Volck, County Horticultural Commissioner of Santa Cruz County, and who has had considerable experience with this pest, writes as follows concerning control measures.

> "In my work with the potato worm I found that hilling largely prevented the infection of the tubers. The rows should be about 40 inches apart to allow of good hilling and the land should be cultivated thoroughly to get rid of clods and make it as fine as possible. In sandy lands the tubers are more easily protected than clay or adobe. The hilling should be commenced rather early or as soon as the tubers have formed, and a second hilling about a month before digging is advisable.
>
> I also found that infested tubers could be freed from worms by soaking in water for 36 hours. If cold water is used and the temperature of the vats is kept below 60° F. the tubers are not injured in any way. The disinfestation is complete so that the tubers so treated may be stored for an indefinite period without danger of becoming wormy.
>
> Quite frequently, early rains may bring about the same result before digging."

Literature.

Those who desire to better acquaint themselves with the habits, destructiveness and control of the potato tuber moth should look up the following references:

1873. Beitrage zur Kenntniss der Nordamerikanischen Nachfalter, 62.
1874. Jahrbuch Soc. Cent. Hort.
1878. Can. Ent. X, pp. 50-54.
1879. Bull. Soc. Ent. France, pp. 146-147.
1880. Proc. Linn. Soc. New So. Wales, IV, pp. 112-114.
1883. Injurious Insects of the Orchard, Vineyard, Etc., by Matthew Cooke, pp. 313-315.
1885. Papers and Proc. of Royal Soc. of Van Diemen's Land, III, p. 76.
Trans. and Proc. of Royal Soc. So. Australia, IV, p. 57.
1889. Rep. Insect and Fungus Pests of Queensland, Australia, No. 1, pp. 175-181.
1891. Insect Life, III, 435.
1892. Rep. Secy. U. S. Dept. of Agric., p. 156-7.
1892. Insect Life, IV, pp. 239-242.
1893. Handbook of Destructive Insects of Victoria, p. 147.
1894. Rep. of Biologist, New Zealand Dept. Agric., pp. 42-44.
1898. Rep. Gov. Entomologist, Cape of Good Hope, p. 48.
1901. Bull. No. 135, Cal. Agrcl. Exp. Station.
1907. Bull. No. 7 New Zealand Dept. Agric., pp. 33-35.
1909. Indian Insect Life, p. 535.

PRUNING THE LEMON.

By R. S. Vaile, Horticultural Commissioner of Ventura County, Santa Paula, Cal.

An easterner once remarked to the writer in the course of a trip through the various citrus districts of southern California, "How many different kinds of lemon trees there seem to be." Certainly, to one unfamiliar with citrus culture there appear to be numerous types, but the difference lies not so much in the kind of tree, the soil and climate, as in the method of pruning employed. Many of the vicinities have

their own particular way, many of which are based simply upon the hobby of some one man.

All of these various methods are, or at least should be, seeking for the greatest efficiency along certain lines which may be grouped somewhat as follows: Strength of the main branches in upholding the crop of fruit; check of the spread of trees so as to permit of ample cultivation of the soil between and underneath the trees; increase of the bearing surface, especially of the fruit-bearing wood; protection of the fruit from wind bruises and frost; admittance of light and air to the interior of the tree; and ease in picking the fruit. The type of tree which most nearly satisfies these requirements is most nearly the ideal tree.

In taking up these points more in detail, let us begin with the trees

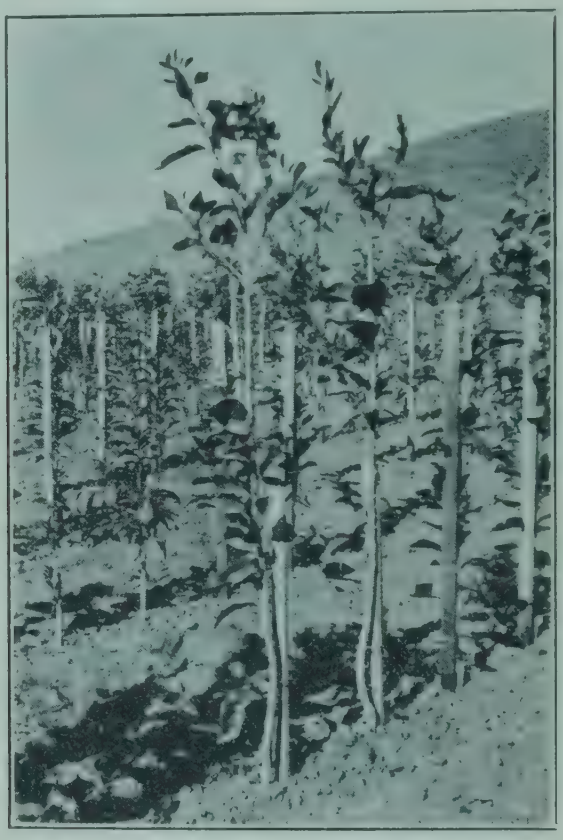

FIG. 83.—Well-headed nursery trees. (Original.)

still in the nursery. There is considerable difference of opinion as to the proper height at which to head the young tree—nursery practice varying from two feet or even less, to four feet (Fig. 83). There are at least three factors which enter into this question, the first of which is the strength of the main branches. General practice is limiting these to three or four in number, and it undoubtedly would add to the strength of the frame if each of these branches could come direct from the main trunk without in any case an equally divided crotch which will permit of splitting. To reach this condition the branches must be from three to six inches apart. This would necessitate the final head being a foot higher than otherwise in order to keep the lower branches from the

ground. Next comes the question of ventilation and aëration under the trees. If the head is low (Fig. 84) there is but little chance for air circulation, and a tendency for the soil to sour. Almost invariably the branches will hang to touch the ground, thus increasing the probability of brown rot and kindred troubles. On the other hand if the tree is properly aired, considerable fruit can be produced on the inside wood, and in the picking of this fruit it is well-nigh essential to have the branches not only started high, but they should also have a decided upward tendency for several feet.

Let us, then, assume a fairly high head of three or four main branches. The next question in the young tree is the length at which to cut back these main branches. In order to force early bearing as well as to develop strength, many orchardists practice cutting in short lengths of from one to two feet. Each of these cuts means two or three branches in place of one, and before many years, the tree is very thick with large, non-bearing wood. While this method may be all right to force young trees, it does not produce the ideal type without later thinning. It seems to the writer that the ultimate tree should have its

FIG. 84.—Lemon tree with head too low. This tree is also apt to split. (Original.

main branches running upward through the tree as nearly straight as possible. To attain this, the cuts should be made from two to four feet in length, and any excess fruit removed for a year or so to permit sufficient growth to support the crop.

It is a principle that holds through practically all botany that the younger wood fruits more prolifically than the older. To this end, the main branches and their larger tributaries should be made to throw out new small wood each year, and a certain amount of the old should be cut completely out to make room for it. This new wood should be trained into any openings left by the removal of other wood, and should also be trained to grow downward rather than upward. This may be

done where necessary by placing the shoots under the branches until they have grown into shape.

The writer is strongly in favor of two prunings each year for the lemon. In the fall the heavy cutting back should be done. Then in the spring after the growth is well started, it may be slightly thinned out and twisted into shape. The next fall, again, any interwoven branches may be straightened and they will then be ready to set fruit.

This type of pruning, which is really a combination of many so-called methods, produces a thick outside growth of leaves, thus protecting the fruit from wind and frost. It keeps the tree well off the ground, permitting ample aëration, and reducing danger from brown rot to a minimum. It limits the number of branches which might interfere with picking and cultivation, and above all, it permits of continuous substitution of new fruit wood for old.

FUNGOUS ROOT ROT.

By Wm. Titus Horne,

Assistant Professor of Plant Pathology, University of California, Berkeley, Cal.

The disease here called fungous root rot is known by a variety of names, such as oak-fungus disease, toadstool disease, etc. Professor R. E. Smith believes that several fungi may be involved, but thus far he has found only one fungus, *Armillaria mellea,* clearly causing the typical symptoms. A brief article by the writer, treating of this disease, was published in the Proceedings of the Thirty-seventh Fruit Growers' Convention, under the title, *Root Rot of Citrus Trees.*

Few diseases affect as great a variety of plants as this one. It appears to be capable of attacking almost any plant which is somewhat woody or long-lived. It is found throughout the State, probably in every county where there has been a natural growth of trees, although we have not as yet received specimens of it from all counties. There has been an impression that it does not occur in southern California, but this is erroneous, as it has been found abundantly in districts which had large trees growing in them before they were cleared for orchards; the writer has found very fine specimens of it in the city of Pasadena, and it is known to occur in Riverside, although it is rare. It is probably true, however, that the more copious rainfall of the central and northern sections is favorable to the disease.

The trouble is a familiar one to most orchardists, but I will point out its most characteristic symptoms. In the first place it works in very limited areas which enlarge from year to year. Numerous spots of infection may overlap or very old spots may spread so widely that the boundaries become irregular, and simple spots are not recognizable in the orchard.

One of its most striking and characteristic features is the appearance of clusters of large, light brown toadstools during November and December (Figs. 86, 87 and 89). The writer's experience seems to show that these toadstools are to be found only in the early winter or late fall.

Specimens often appear in October, while the latest fresh ones which we have recorded were found January 24th on Boston ivy in Berkeley. A great many species of toadstools occur in every country and it is a

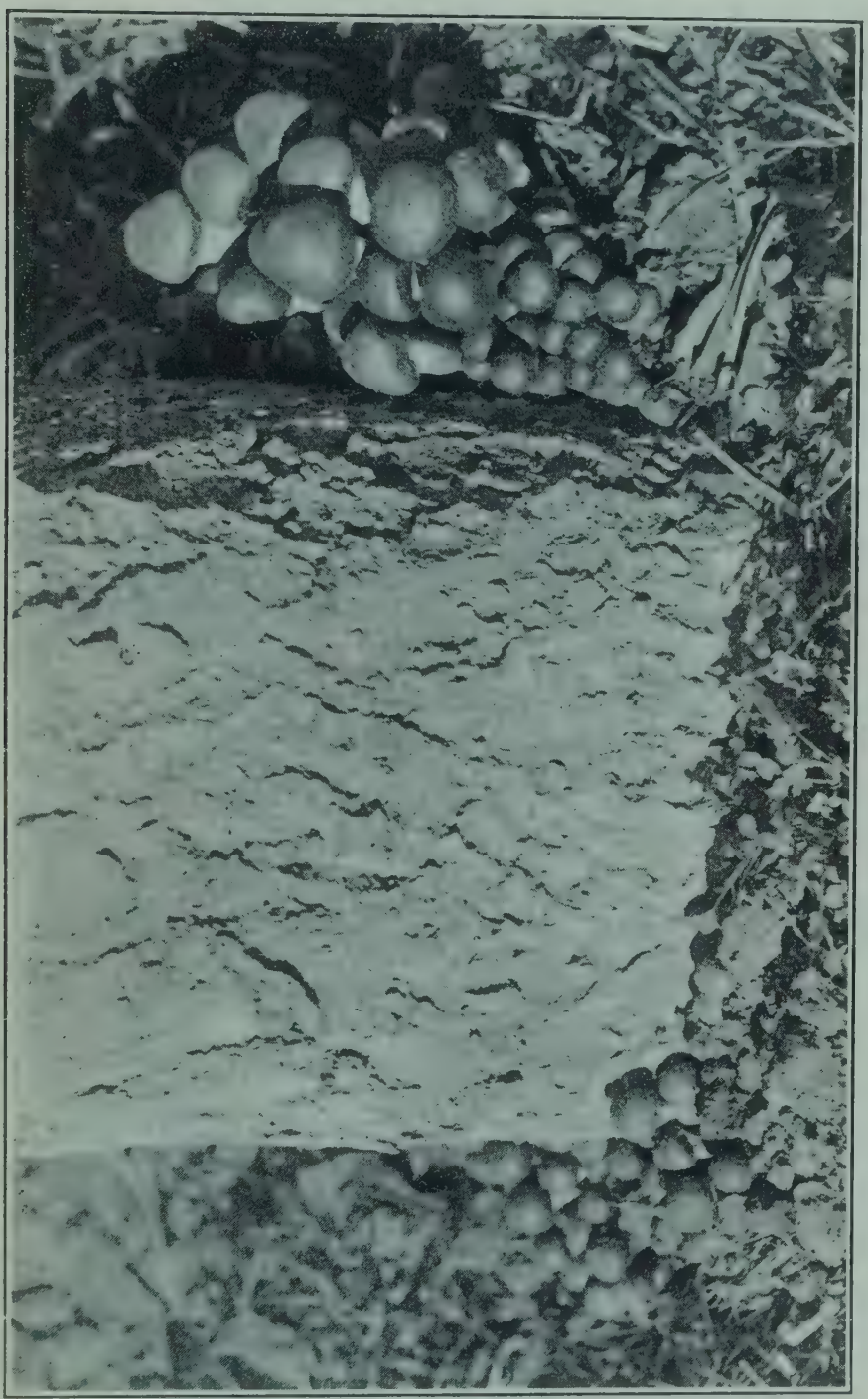

FIG. 85.—Toadstools of *Armillaria mellea* in the button stage coming up around the base of a large English walnut tree which is rapidly dying. Several very fine large English walnuts were killed in an orchard in one year, but not a single one on the black root died, although intermingled in the same grove. (Photo by the California Agrcl. Exp. Station.

very difficult matter to distinguish one from the other. However, the toadstools of root rot will be found always to arise from a decayed root or part of the plant below the ground, and this will partly serve to

identify them. They usually appear at the side of the affected tree (Fig. 87) or encircling it (Fig. 85), often while it is still partly alive, but they may come up at some distance from it, where an affected root comes near the surface of the ground. These toadstools produce im-

FIG. 86.—Group of toadstools on an old oak stump at Berkeley showing well developed specimens of *Armillaria mellea* taken in December. In the lower central part of the picture white spore masses can be clearly seen below the overlapping tops. Three crops of these toadstools have been under observation in successive years on this stump. These have developed under favorable conditions in a very moist time. (Photo by California Agrcl. Exp. Station.)

mense numbers of microscopic spores which often cover the ground or the leaves below them with a white powder (Fig. 86). The spores are capable of growing and reproducing the fungus again, as has been shown repeatedly in our laboratory. Without doubt a healthy group

of the toadstools produces spores enough, if they were properly distributed and successfully germinated, to affect every cultivated tree in the State of California. The principal reason why this has not happened is probably that these spores are not capable of attacking a living plant directly, but must get established first in some dead material, and the great majority of them are dried out and die before gaining sufficient force to be parasitic.

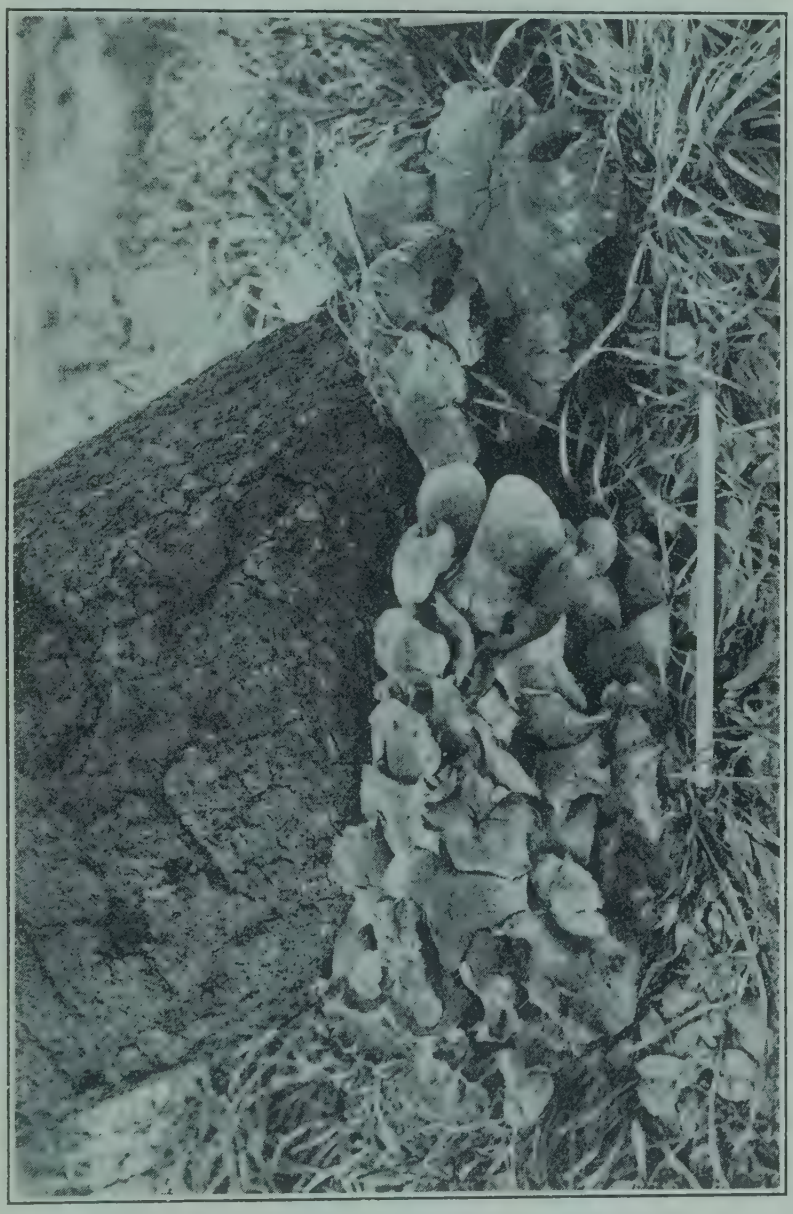

FIG. 87.—*Armillaria mellea*, well developed toadstools about the base of an old oak tree at Berkeley. The rule in front is a centimeter rule twelve and one half inches long, but owing to perspective effect the tree appears larger than natural. Cracks in the bark at the left show that the mycelium of the fungus is working below the surface. Just above the part shown in this picture the bark was partly cut away and the mycelium which is shown in Fig. 88 was exposed. (Photo by California Agrcl. Exp. Station.)

A third characteristic feature of the root rot fungus is the formation of felty white growths which spread out in a somewhat fan-shaped manner within the bark of affected trees (Fig. 88). The particular thing which is characteristic of this fungus as distinguished from others which may be found in the dead bark is that these fan-shaped white masses of mycelium crowd directly into the perfectly healthy

living bark, with the result that this puffs up and becomes watery and often filled with gummy or gelatinous material. The fungus continues to work in the affected tree if sufficient moisture is present, causing a very complete white rot of the wood. The odor of the decay produced is not putrid or sour, but a sharp, clean, mushroom smell. The trouble may be recognized at any season of the year by these characteristic white felty growths crowding into and immediately destroying the healthy tissue of the bark.

A fourth feature, found only, so far as the writer knows, in connection with this fungus, is the formation of shining, black, cord-like

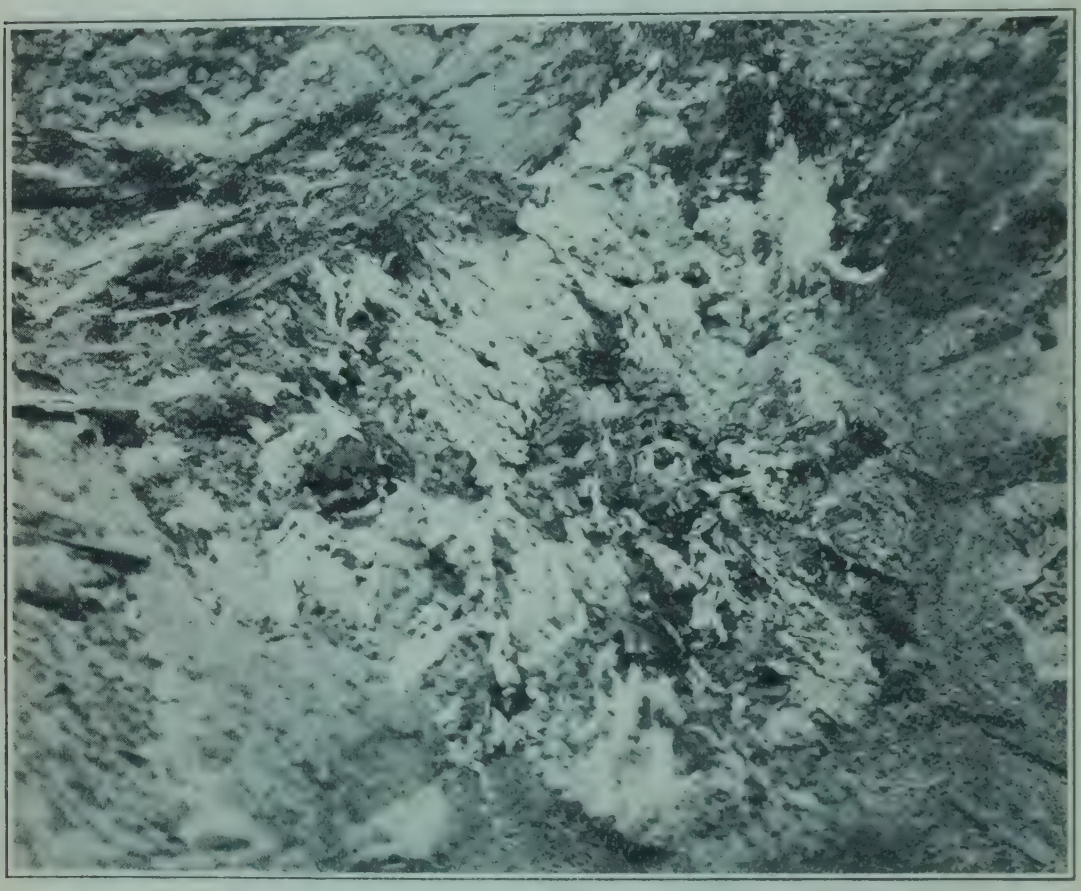

FIG. 88.—White mycelium of *Armillaria mellea* in the bark of an old oak tree at Berkeley. This shows the mycelium penetrating into healthy bark, and it has here reached a height of about four feet above the ground. In citrus and stone fruit trees the mycelium rarely gets more than a foot above the surface of the ground. The surface of the bark showed nothing more than being slightly puffed and cracked with a little gummy sap exuding. The hard surface bark was cut away, exposing the mycelium in the red, juicy inner bark. A few days after taking this picture the tree was blown down owing to underground decay on one side. (Photo by California Agrcl. Exp. Station.)

strands (Fig. 90) about one sixteenth of an inch in diameter. They need not be confused with small roots, because of their method of branching. They give off no fine branches, but occasionally fork. These strands are called rhizomorphs, and are compact bundles of the very fine fungous threads, the outer layer of which, in contact with the air, becomes hard and black. They grow out from the affected parts,

where the fungus is abundant and vigorous, and are able to penetrate through the soil for several inches or perhaps more. If they come in contact with a healthy root they attack it directly as a parasite, and

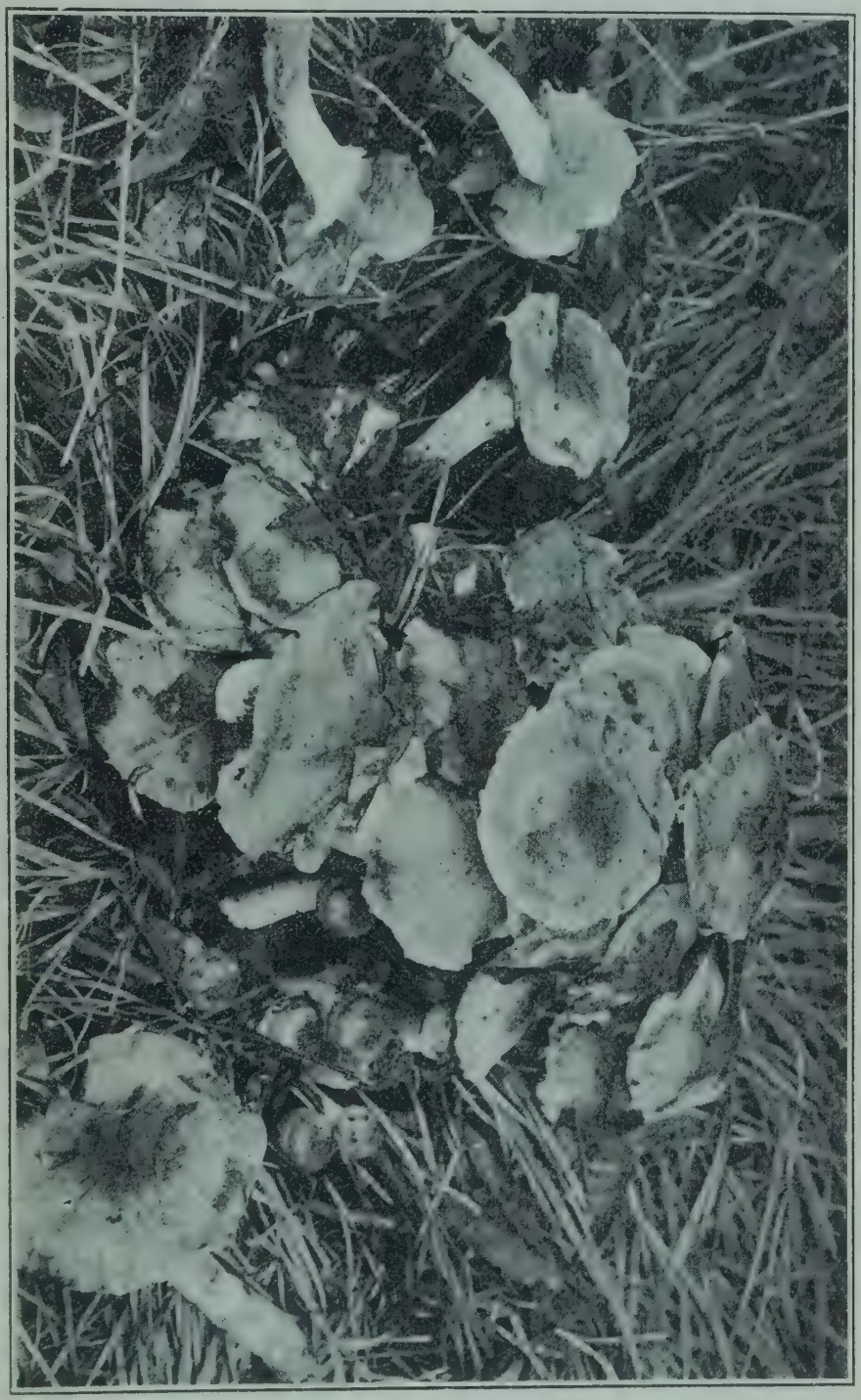

FIG. 89.—*Armillaria mellea* toadstools near the base of an orange tree which is half dead. This is a very light colored form coming up in a wet time and well protected by tall grass. (Photo by California Agrcl. Exp. Station.)

send out the microscopic threads which penetrate into the bark and commence the work of destruction in a new place. No doubt the fungus spreads principally by growing along the roots, but these rhizomorphs

must be of great assistance in helping it to pass through distances of a few inches from one root to another.

The probability of starting new centers of infection from the spores produced by the toadstools appears from actual experience to be small.

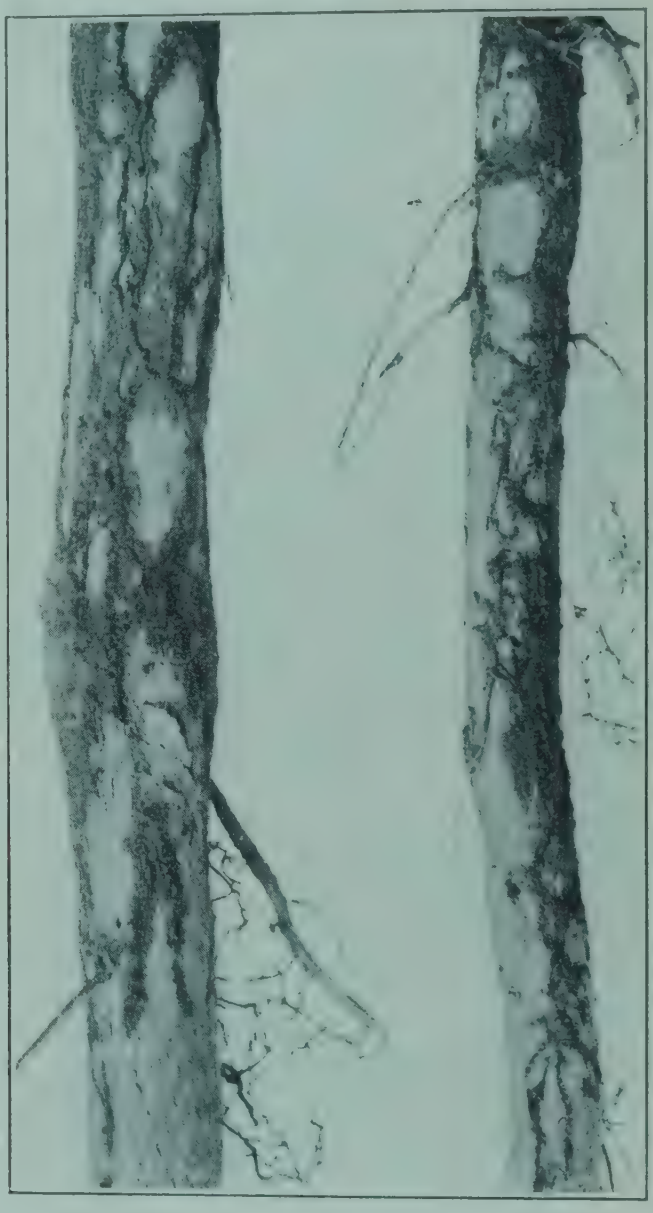

FIG. 90.—Citrus roots being attacked by the black strands or rhizomorphs of *Armillaria mellea*. If the affected roots are cut open the bark will be found to be rotten and filled with white felty fungus. These were from a pine tree growing in unusually fertile soil. (Photo by California Agrcl. Exp. Station.)

However it will not cost much in labor to largely avoid this risk by destroying the toadstools before the spores are formed. If dug out and exposed to drying weather while in the button stage (Fig. 85), no spores will be developed. If expanded, or nearly so, when found, there

would not seem to be much advantage in removing them. The whole group might be sprayed with some of the stronger fungicides, such as copper sulfate, 3 pounds in 50 gallons of water, or with a strong lime-sulphur solution.

The treatment of spots affected with root rot in orchards will naturally fall into two phases—one, the treatment of the area already known to be infected with the fungus; the other, the treatment of the margin or advancing front of the infection.

The writer believes that the safest and best way to treat the infected area will be to remove as much as possible of the old roots, by means of dynamite or otherwise, and burn them or allow them to dry thoroughly. The land may then be planted to annual crops or perhaps alfalfa, unless we should find that the latter crop is attacked by the root rot fungus. After a term of years the space may be replanted to trees, but at present we have no reliable data as to how long this would need to be. There are cases where very large holes have been dug and the affected roots removed, new soil brought in, and trees set in this, with the result that they have lived for five or six years or perhaps more. The possibility remains, however, that as soon as the roots come in contact with the remains of the old diseased roots in the soil, they may become infected and after a time the new trees may die out (Fig. 91).

It has frequently been suggested that there may be some immune plants, and that these should be set in the affected areas. Pears seem to be immune. Other trees have been mentioned as having considerable immunity, namely figs, black walnuts, and cherries; but at least some varieties of cherries succumb. The writer has seen no black walnut with the disease, but believes that it is sometimes killed. Partially immune plants are certainly desirable for situations where the trouble is feared but not known to exist. They should not be planted for a number of years, however, where a tree has died of this disease.

In the writer's opinion, the greatest importance attaches to treatment of the margin of the affected area to prevent the further spreading of the fungus if possible. The condition which already exists in some orchards in the older settled sections is an exceedingly undesirable one. Where a spot has enlarged until it has passed over the whole of a small orchard and the trees have been replanted, some succeeding and others dying out, there is no assurance that any place is free from the trouble, and, as a matter of fact, it is probable that enough trees will keep dying from time to time so that the orchard can never again be made profitable, considering the exceedingly high prices at which orchards are held. To abandon the trees and grow truck or alfalfa is often impractical or would mean a great sacrifice. The enthusiastic tenderfoot offers the owner a tempting way to escape, but this does not remedy the matter as far as the orchard is concerned, and, in such a case, there is no remedy to suggest.

Where the trouble is still confined to one or more distinct spots, it has been suggested that a number of healthy trees should be uprooted in the zone of advancing infection, hoping thereby to remove enough roots so

that the fungus will not have anything on which to travel through the soil. If done with sufficient thoroughness this may be effective, but it must be borne in mind that all the larger roots must be gotten out of

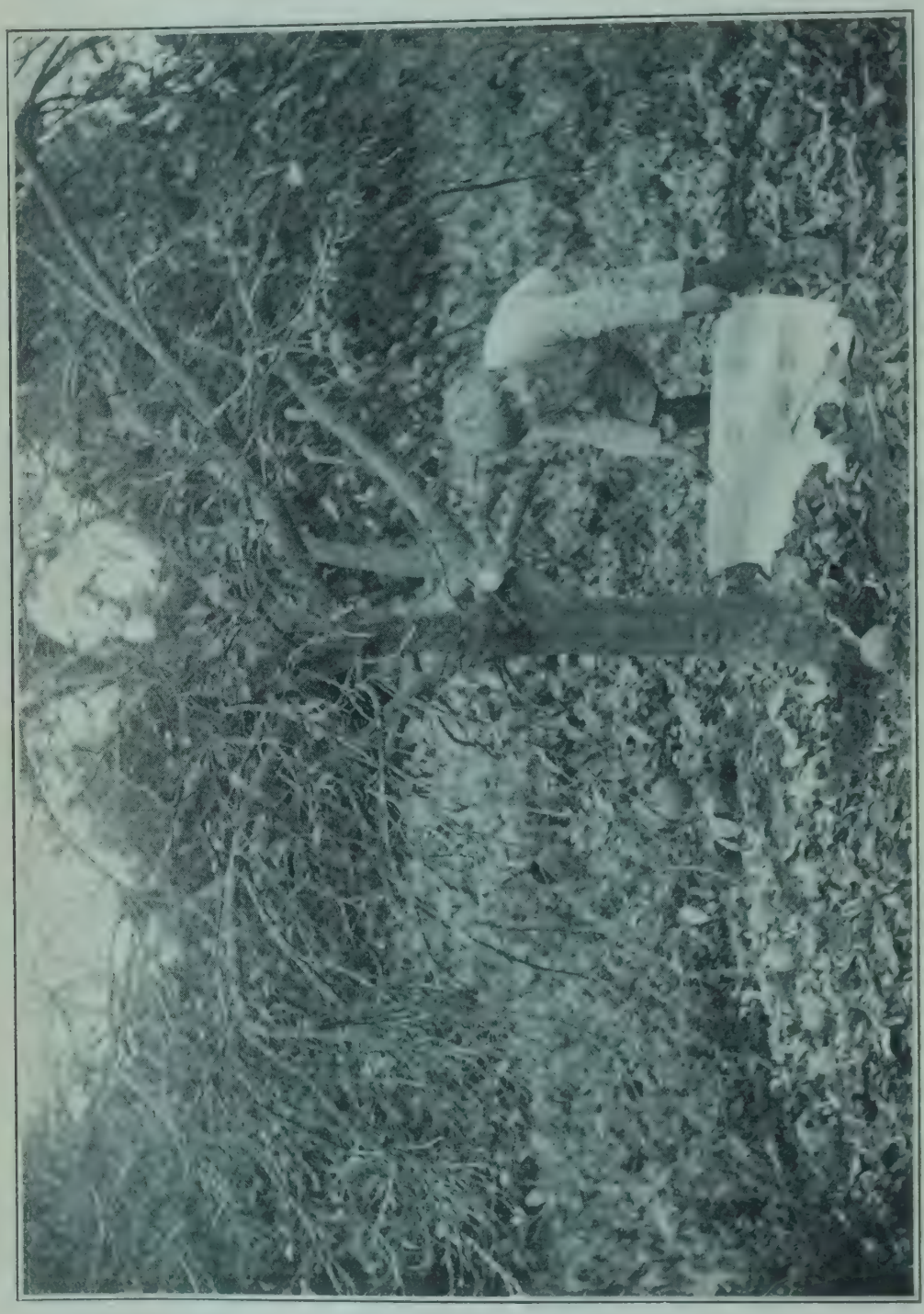

FIG. 91.—A typical case of root rot taken in December. Toadstools are coming up about the base of this grape-fruit tree. Its roots are completely killed, but a little foliage and fruit still remain on the dying top. This was at the edge of a spot in which five trees had died previously. It is believed to be on sour orange root. (Photo by California Agrcl. Exp. Station.)

the cleared strip. Many people would prefer to take the chance of losing the whole orchard in time rather than make the sacrifice involved in this treatment.

We have been trying some experiments in endeavoring to isolate the affected trees by digging a trench deeper than the point to which the roots penetrate between the trees, lining the side of this ditch with tarred paper, and replacing the soil so that cultivation and irrigation may proceed as usual. The theory of this proceeding is to prevent the healthy roots from passing over into the diseased area. There has not yet been time to form an opinion as to the success of this treatment.

It is possible that the disease may be transported on the roots of nursery stock, but this will occur exceedingly rarely, because the fungus does not attack fine roots and usually appears to start on a deep root. Replants have been found with the fungus on their roots at the end of the first year, but this would rarely happen in the nursery, and, if the trees were not balled, the affected part would be seen and removed or the tree rejected by any careful planter.

The whole situation in regard to root rot is one that does not call for alarm or haste; it is not likely to increase suddenly and present methods of dealing with it are somewhat uncertain. However, it should be receiving our careful attention because it is an exceedingly widespread trouble and is much more abundant than is generally supposed.

THE PEAR THRIPS IN 1912.

By G. E. Merrill.

Damage.—The ravages of the pear thrips this year were not so severe as was anticipated by many. In the Santa Clara Valley, as nearly as we could learn, they appeared in about the same numbers as last year. The outbreaks in this region, as in the past, were somewhat irregular in their distribution. The pest could be found in practically every district in the valley. It was present in destructive numbers, however, in comparatively few orchards. Perhaps the worst outbreak was in a large orchard not far from Saratoga. In the orchard in question, the crop will probably be a total failure over an area of 40 acres or more. It is significant to note that the owner of this orchard has done no spraying for the thrips during the past few years. In not many cases was the area of destruction more than a few acres in extent, and often only a few trees were seriously affected.

In Contra Costa County, the damage from the pear thrips for the present season, in the opinion of Mr. Swett, the county horticultural commissioner, was far less than in any previous year since the pest became a factor in the deciduous fruit production of his county. The small amount of damage was due directly to the small number of thrips that emerged, and indirectly to the absence of the blue mold fungus that frequently appears after the opening buds have been injured by thrips or otherwise.

In Sacramento County, the damage of the present season was markedly less than in previous years. The same statement is true of the older infested territory in Napa, Solano, and Sonoma counties. But in these

last named counties the new infestations were very severe, in some cases apparently promising to ruin the crop.

The damage by the thrips to certain individuals was no doubt severe, but as a factor in the maturing of this season's crop, the pear thrips has not been as important as it was in the crops of a few years ago.

Control measures.— More extensive preparations were made to welcome the pear thrips than ever before. Control of the pest was sought by spraying. Of the various formulas recommended, the most extensive use was made of the various forms of the Blackleaf-distillate emulsion. More than 40,000 gallons of Blackleaf were sold, the larger part of which went to growers in the Sacramento Valley. So much spraying was done in this distict, that it can be truthfully said that a *general spraying campaign* was prosecuted. The small amount of damage done in this district was due no doubt, in part, at least, to the vigorous work of the growers. They are to be congratulated on the spirit with which they met the enemy.

Spraying was also more generally carried on than ever before in the counties of Santa Clara, Contra Costa, Napa, and Solano.

From the viewpoint of the investigator, the thrips season just passed has not been as satisfactory as he could wish. In few cases have the thrips been abundant enough to furnish, at this date, a marked contrast between the sprayed and the unsprayed parts. Under these conditions, to judge of the relative merits of different sprays is difficult. Air-tight conclusions on this point then must be deferred until another season has come, more favorable to the work of the pest.

THE ECONOMIC STATUS OF THE MEADOWLARK IN CALIFORNIA.

By Harold C. Bryant, Assistant, California State Fish and Game Commission.

Certain disturbances in the balance of nature always follow the advent of man. The best examples of a settled harmony of interaction between organisms is to be found where man has not interfered. We find the natural order of things adjusted to meet natural conditions only. The necessities of man, however, require a reorganization to meet the artificial conditions introduced.

One of the first adjustments to be made by man is the elimination of those things considered harmful and the preservation of those considered beneficial. Until the last few years different forms of life have been classified as injurious or beneficial to man from pure sentiment or circumstantial evidence. Fortunately at the present time a reaction has set in and people desire to know the truth about things. The U. S. Biological Survey, by making a thorough study of the food habits of birds, has proved to us that many species of birds that we thought were very injurious more than pay for the harm they do by destroying injurious insects and rodents.

It is only natural that California with its well-developed fruit and

grain industries should be troubled with all sorts of pests. In order of economic importance, insects naturally come first. Certain small rodents probably can be ranked second and weeds third. Of course, this order changes according to the particular crops raised. The main thing to be seen is that insects are by far the most important of the pests. Anything which tends to keep in check the great hordes of injurious insects must therefore be considered a direct benefit. Probably next to insect parasites, birds are the most important factor in checking the increase of insects. This brings about an important problem the solution of which, to say the least, is difficult. For on one side we have certain birds which act as checks on insects and on the other side the same birds causing considerable damage in orchards and grainfields.

One of the most noted birds belonging to this general class is the

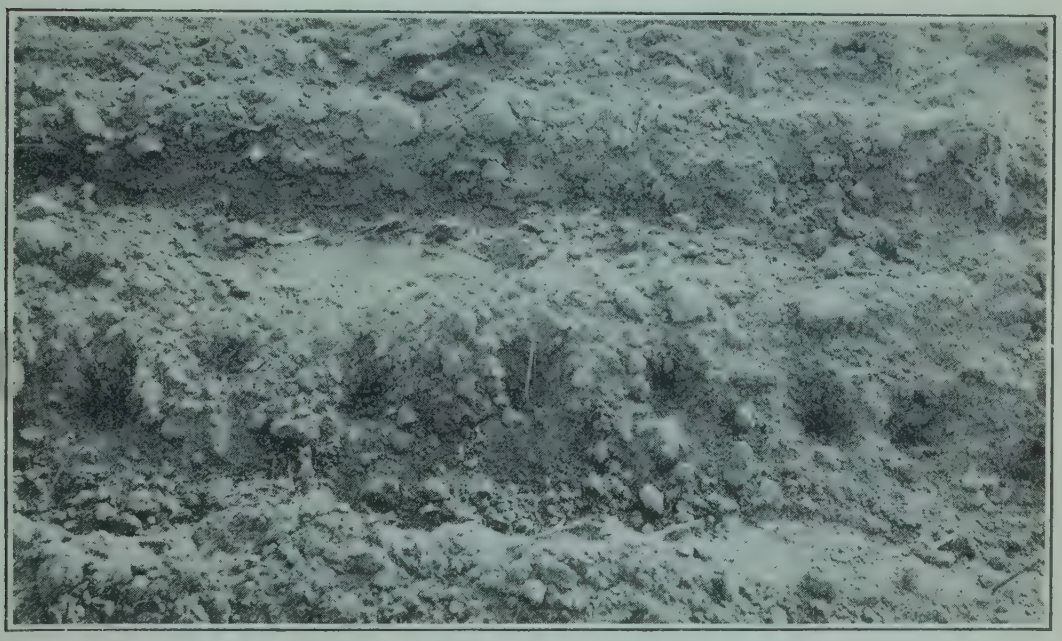

FIG. 92.—Holes drilled by meadowlarks in a field of sprouting grain. Photograph taken by the author at Lathrop, San Joaquin County, California, February 28, 1912.

meadowlark. That its depredations in grainfields are real must become evident when it is known that in the last two legislatures, bills were introduced taking protection away from this bird because of its destruction of sprouting grain. Ranchers in the San Joaquin and Sacramento valleys report having lost from one third to one half of their grain crops due to meadowlarks alone. The loss is a real one because the birds go on to the fields in large flocks and boring down beside the tender sprouts (Fig. 92), pull off the kernels and leave the sprouts to die. Whether the damage in a grainfield could be possibly offset by the insects destroyed by the bird has been a mooted question. The continual complaint against this bird by ranchers and the strong defense of the bird by others caused the Fish and Game Commission to take up a thorough, scientific investigation into its food habits.

As the only fair test of the value of a bird to the people of California is a thorough knowledge of the food habits throughout the year, it was determined to obtain this knowledge by field work supplemented with stomach examination of birds taken in many different parts of the State each month in the year. So far the investigation has shown that meadowlarks do a considerable amount of damage in grainfields in some parts of the State. On the other hand, it has been found that as a destroyer of cutworms and grasshoppers, two injurious insects, the meadowlark is probably unequaled by any other bird. Whether the good done will overbalance the bad or vice versa when the investigation is completed, it is impossible as yet to conjecture. Many interesting things that have been demonstrated in the work thus far are of general interest.

Abundant proof of the depredations of the meadowlark in the grainfields has been afforded by stomach examination. Birds taken during the winter months are found to contain little else than grain. As many as thirty kernels of oats with enough hulls to account for as many more kernels, have been found in a single stomach.

Field investigation has shown that the birds prefer oats, and often do considerable damage in such fields, especially where the birds are numerous and the amount of grain small. It is, indeed, astonishing to see the skillful way in which the birds follow the drill (Fig. 92), and digging down beside the sprout, pull out the kernel. Ofttimes the kernel is simply crushed in the bill and the hull and sprout dropped beside the hole so that the stomach examination does not always show the total damage done. A certain amount of thinning would cause practically no loss to a rancher, but the amount of thinning done in some cases doubtless means a loss, which, if it could be calculated, would be considerable.

The fact that meadowlarks damage a field only when the sprout is just coming through the soil and not after it has reached a height of two or three inches, makes the period of time during which damage can be done of short duration. The fact that oats and wheat are the only grains damaged to any extent also minimizes somewhat the amount of damage done.

After the presentation of this side of the bird's life the question naturally arises, Can the meadowlark possibly pay for the damage done by destroying injurious insects which also cause a loss to the rancher? The investigation has not progressed far enough to admit of a final answer. However, some definite statements can be made as to the value of the meadowlark as a destroyer of injurious insects.

Stomach examination (Fig. 93) has shown the food of the meadowlark to be made up very largely of beetles, cutworms, grasshoppers, crickets, ants, and wood crickets (commonly called Jerusalem crickets). Among the beetles eaten are a number that are predacious ground beetles (*e. g.*, *Calosoma*) and so are usually considered beneficial or at least of neutral value. On the other hand, such injurious

beetles as the Elaterids (*e. g., Drasterius*) are not of uncommon occurrence. In fact, most of the insects eaten are injurious species. As several writers have already pointed out, the destruction of certain beneficial insects by birds does not diminish the value of a bird, for it is the fact that birds feed on insects as a whole and so help to keep up the balance of nature that they are of value, rather than that they discriminate between useful or harmful insects.

As a destroyer of cutworms and grasshoppers, as stated above, the meadowlark is probably unequaled by any other bird. As many as sixty-six cutworms have been found in a single stomach and thirty pairs of mandibles of grasshoppers. When it is known that the time of digestion for these insects is only one to three hours, it becomes evident that the number of these injurious insects destroyed in a day is very great.

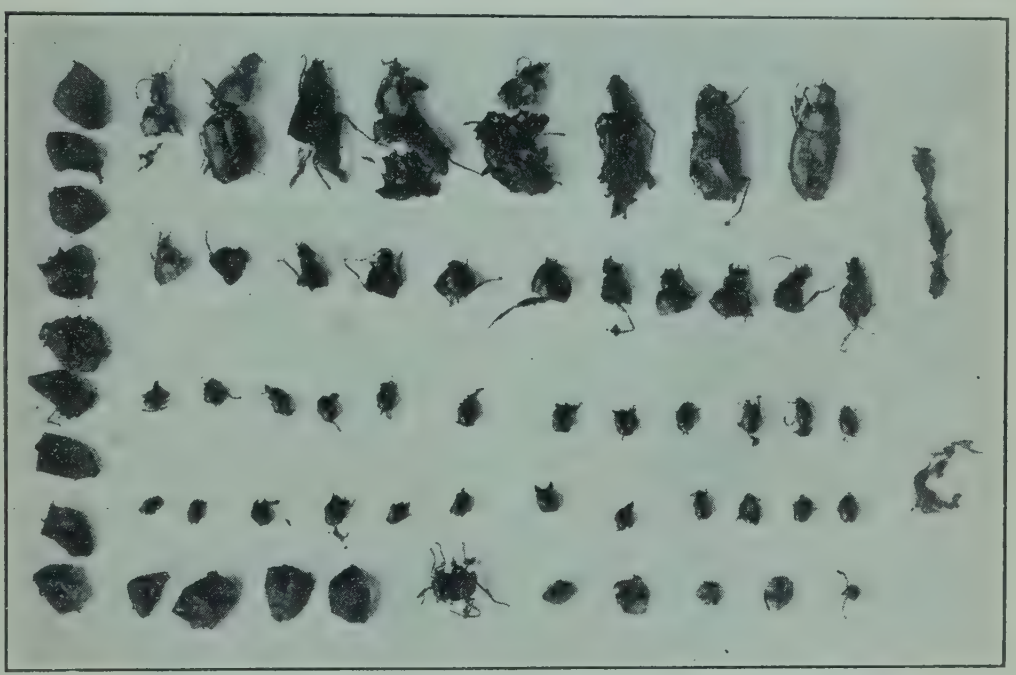

FIG. 93.—Photograph of stomach contents of a meadowlark which was taken in a barley field at El Toro, Orange County, California, May 3, 1911. The stomach contained 2 cutworms, 44 ground beetles (*Calathus ruficollis*), 2 flies, 1 spider and 13 pupæ (*diptera*). (Original.)

Stomachs of birds collected in grainfields during the months of April and May have been found filled with cutworms almost exclusively (see Table 1). Birds taken during the summer months are found to contain grasshoppers to such an extent that the average ranges between seventy-five and ninety per cent. It thus appears that the birds in the same locality where they do damage, later on perform a valuable service in exterminating insects which are well known as destroyers of grain. A table showing the percentages, numbers, and kinds of insects taken in alfalfa fields as computed from birds killed while feeding in these same fields, clearly shows the value of meadowlarks in such localities and also shows how the crop raised may so alter conditions that birds which may

be pests in some localities become the best of friends (Table II). The systematic destruction of crickets, ants, and of the wood cricket (*Stenopelmatus*) further emphasizes the value of the bird.

Another important factor that governs the amount of good or harm done by any bird is the number of individuals present. Practically no complaint against the meadowlark comes from southern California, simply because the number of these birds is so small and the consequent destruction of grain slight. In the interior valleys of the State, however, meadowlarks are very numerous and the damage to grainfields is very apparent.

Another complaint against the meadowlark arises from its habit of drilling holes in melons. Peculiar local conditions are usually to blame when this occurs for the complaint is not widespread. In this case, also, the period of time during which loss results is of short duration for after there are broken melons in the field, the green melons as well as the sound ripe ones are untouched.

It will be noted that there has been no attempt made to take either side of the question, but rather to simply state facts. One conclusion, however, seems warranted by the facts presented. The amount of good or harm done depends very largely on locality and the kind of crops raised. Whereas meadowlarks may be harmful in certain localities, in other localities they may be of inestimable value. To the grain-grower the meadowlark may be a foe, but to the grower of alfalfa it may be, and doubtless is, a valuable friend. The thorough knowledge of the food habits of the meadowlark, which will be available when the investigation is completed, will certainly furnish abundant evidence as to the real value of this bird to every one concerned.

TABLE I.

Comparison of the food habits of the meadowlark for different months of the year. Birds collected in grainfields in the vicinity of Red Bluff, Tehama County, California. Average of six birds for each month.

Month.	Per cent of animal foods.	Per cent of vegetable foods.	Per cent beetles.	Per cent cutworms.	Per cent grain.	Per cent of grasshoppers.
January	1.0	99.0	1.0		94.0	
February	38.5	61.5	3.6	31.0	41.6	
March	87.2	12.8	22.7	20.6	10.6	
April	73.6	26.4	5.2	51.0		
May	99.9	.1	6.2	69.0		4.0
June	96.5	3.5	3.0	15.0		57.5
July	91.3	8.7	4.7		6.3	85.5
August	75.2	24.8	2.1		15.6	72.6
September	88.0	12.0	7.8	3.2		61.2
Average for nine months	72.3	27.7	6.4	21.0	18.6	31.2

TABLE II.

Percentages of food of meadowlarks taken in alfalfa fields in the vicinity of Hanford, Kings County, California.

	Animal matter.	Vegetable matter.	Number cutworms.	Per cent cutworms.	Number beetles.	Per cent beetles.	Miscellaneous.
1	100		3	50	4	15	1 wood cricket (Stenopelmatus)
2	96	4	2	30	7	46	1 wood cricket (Stenopelmatus); 1 hymenoptera
3	100		25	80	9	20	
4	98	2			1	6	1 wood cricket (Stenopelmatus)
5	100		5	65	2	12	1 diptera; 3 ants
6	96	4	19	76	6	20	
7	100		9	60	7	20	10 ants
8	88	12	23	75	4	10	1 diptera
9	85	15	1	10	7	75	
10	94	6	21	83	2	8	1 pupa (?)
11	100		2	80	2	20	
12	100		1	16	10	76	1 diptera
13	100		4	55	6	20	17 small diptera
14	100		4	85	3	15	
15	17	83	2	10	1	4	1 ant
16	100		8	60	5	14	1 cricket (Gryllus); 2 ant lions (Myrmeleon)
Totals and averages	92.1	7.9	129	52.1	76	24.3	16.1

NATURAL CONTROL OF THE CITRUS MEALY BUG.

By A. S. Hoyt.

Probably nowhere in the State of California has the natural method of control been applied more persistently against the citrus mealy bug (Fig. 94) than in Chula Vista, San Diego County. In some of the orchards of that place for a period of nine years no fumigation or spray has been employed. During this time the greatest care and attention have been bestowed on the rearing and distribution of beneficial insects.

At the instigation of Mr. Frederick Maskew, at that time assistant superintendent of the State Insectary, a tent, belonging to his division of the State Commission of Horticulture, was set up over a lemon tree in the orchard of Mr. C. H. Stuart, County Horticultural Commissioner. This tree was thoroughly stocked with mealy bugs, and colonies of *Cryptolæmus montrouzieri* and **Cryptogonus orbiculus* (Fig. 96) were then introduced. Of these two, the former, known familiarly as "Cryps," by the growers in that vicinity, has been by far the most important factor in the natural control of the pest. The latter, called "Gonus," have only been able to maintain their existence and have not yet been known to accomplish results of any great value.

Shortly after the installation of this tent, under the advice and direction of Mr. Maskew, another was started by Mrs. Copeland for the benefit of the Copeland orchards. Here the "Cryps" were bred out in large numbers and liberated in the orchards.

By reason of a very serious infestation of mealy bugs, the ladybirds had an unusual opportunity. With egg-masses hanging in clusters all over the trees, and mealy bugs in all stages of development, present in

*This word is commonly and wrongly spelled *Cryptogomus*.

countless numbers, food was not wanting for the predators. Small wonder is it, then, that they thrived and spread rapidly from tree to tree and from orchard to orchard. So rapid was their spread, and so remarkable their work, that there resulted an almost complete extermination of the mealy bugs, and in one three-acre grove it was only by the most careful inspection that one of the pests could be found.

With this achievement to their credit, the farmers naturally began to look to the "Cryps" for permanent relief. However, after cleaning up the orchards in this remarkable manner, it became more and more difficult for these small friends to obtain food. So marked was this condition that in but a short time the ladybirds were scarce where they had

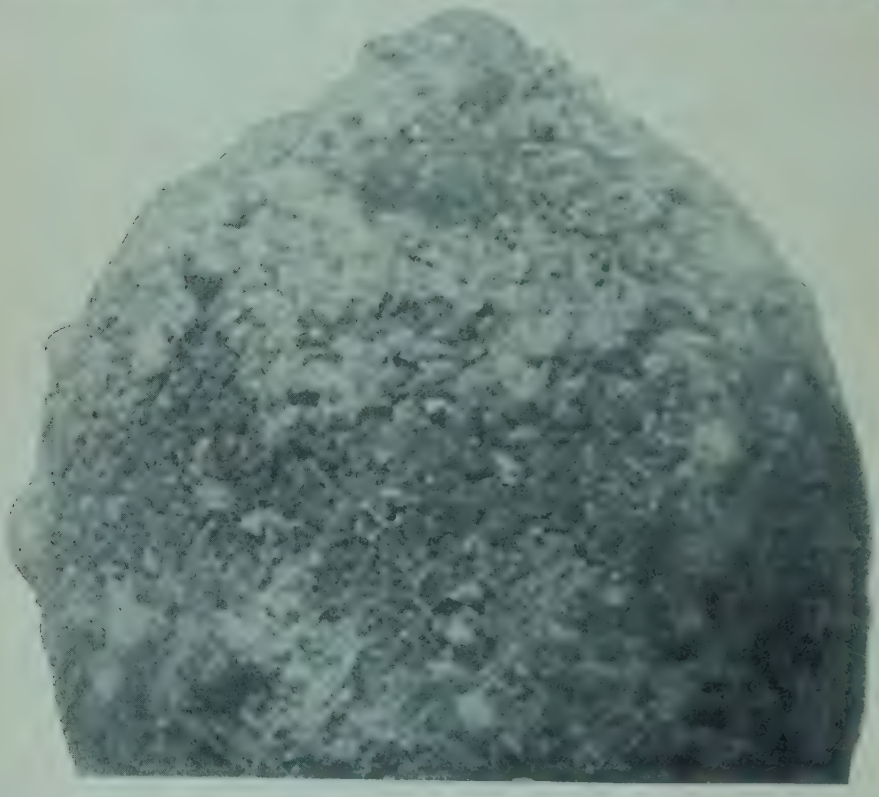

FIG. 94.—Citrus mealy bug (*Pseudococcus citri*) on a lemon. The egg-masses, young and adult females are all present. (P. C. Jr. Ent.)

been present before in large numbers. The mealy bugs began to reappear, and by the following fall and early winter gave every indication of again attaining their former status in the orchards. With abundance of food and favorable weather, it was decidedly their "inning," as a rapid increase in the infestation promptly showed. To the consternation of the growers, the "Cryps" failed to show a corresponding increase in numbers. This situation reveals a weakness in the natural method of control. The pests were returning much more rapidly than the predators, and during the time required for the latter to attain sufficient numerical strength, the former were enabled to inflict great damage in the groves.

The result of this method of control is at once apparent. While orchards which have been neither fumigated nor sprayed for nine years

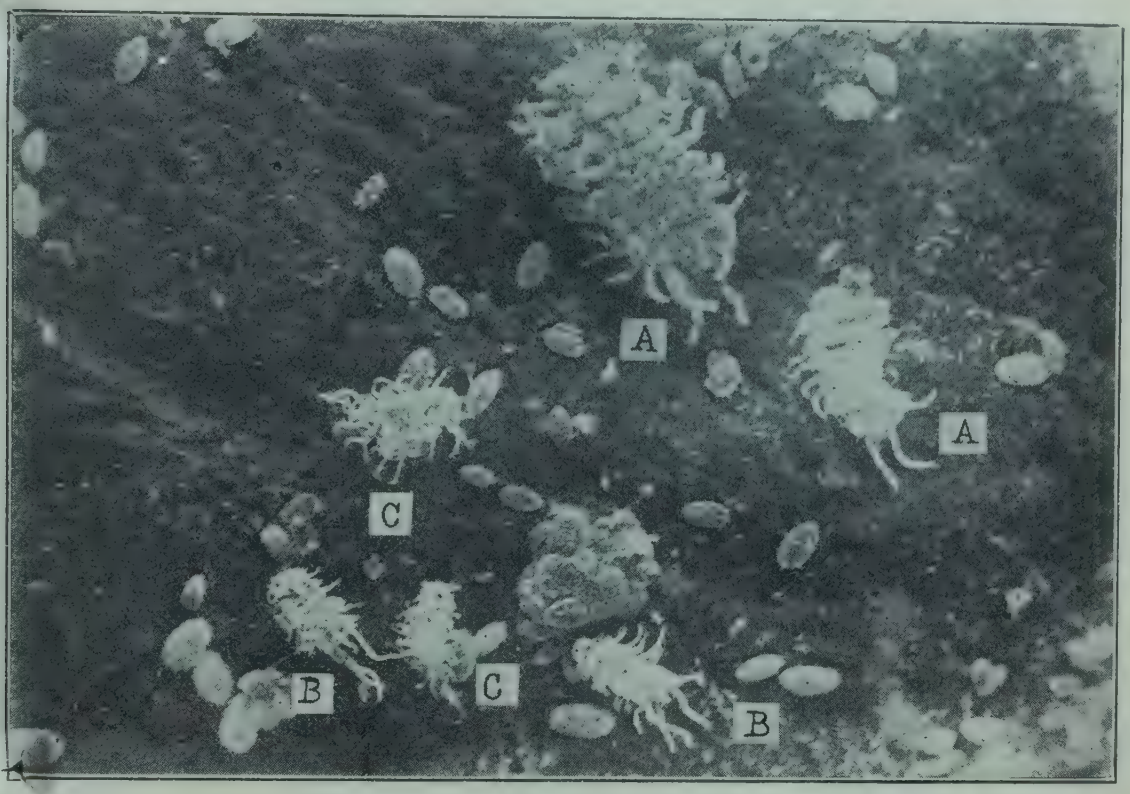

FIG. 95.—Larvæ of ladybird beetles preying upon the citrus mealy bug. A, *Cryptolaemus montrouzieri* Mul.; B, *Cryptogonus orbiculus* Schon.; C, *Scymnus guttulatus* Lec. (P. C. Jr. Ent.)

are surprisingly clean, yet they present on the whole a very different aspect to those which have been treated under the most modern and up-to-date methods of mechanical control. Dirty fruit marks the orchards which have been left to our insect friends. Blackened and smutty foliage and limbs are another frequent and common sight. The most important and serious result of this method of control, however, is the striking absence of fruit-bearing wood on the interior of the trees. The heavy crops of fruit must, of necessity, be borne on the outside, for there are no small twigs and branches inside to support them.

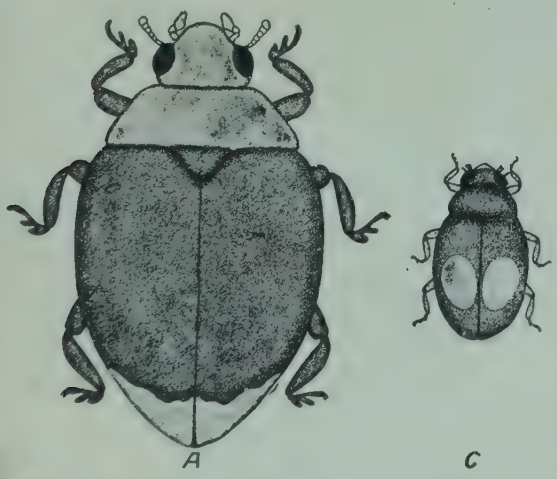

FIG. 96.—Natural enemies of the citrus mealy bug. A. *Cryptolaemus montrouzieri* Mul. is a black ladybird beetle with reddish head, prothorax and the posterior portion of the elytra; C. *Cryptogonus orbiculus* Schon., is much smaller than the former, black with two circular reddish-brown spots on the elytra. The drawings show comparative sizes. (P. C. Jr. Ent.)

To the writer it would seem that the method of control now practiced in the groves of the San Diego Fruit Company is the best way to insure clean fruit and healthy trees, and at the same

time employ, as far as possible, predacious insects. It is the custom of that company to spray for mealy bug only such trees as are badly infested, and in which the "Cryps" have failed to subdue the pests. All trees in which the ladybirds (Fig. 95) are found actively at work are left to their care and every attempt is being made to foster and promote their work.

THE RELATION OF FUNGOUS DISEASES TO STATE AND COUNTY QUARANTINE.

By H. S. Fawcett.

Perhaps nowhere in the world have the methods for quarantine and control of insect pests been so thoroughly developed and perfected as in the State of California. In certain localities injurious insect pests have been controlled and completely or practically eliminated by the cooperation and combined action of the quarantine officers and people of the community, and many injurious pests have been kept out of the State for years by effective quarantine at the ports of entry, but what assurance have we that a destructive fungous disease may not at any time get into the State, from other states or from foreign countries? The quarantine officers have their eyes peeled for the detection of insects and for the more evident fungous diseases, but as a rule they are not even expected to be skilled in detection of obscure fungous diseases.

Quarantine against injurious insect pests has come to be recognized as one of the most important and necessary things for the protection of our agricultural interests. What it has saved the State of California would be difficult to estimate. Many believe that the keeping out of injurious insects has saved some of our industries from certain ruin. From what is known of the Mediterranean fruit fly in other countries it is not hard to predict what would happen to the fruit interests should this pest become thoroughly established throughout the State.

What applies to the keeping out of insect pests many people are beginning to feel should apply equally, or perhaps even more, to the keeping out of injurious fungous enemies of plants. Some of these fungous enemies are fully as threatening as insects, and when once established, harder to deal with, and often impossible of complete eradication. Insects can be seen and detected when present, at least with a hand lens, but many of the fungi are so small and obscure in some of their stages, that they can only be seen with the aid of a compound microscope and then only by special methods.

After once being studied, however, most of them may be known to be present as readily as insects by their effects on the plants. Certain characteristic marks or symptoms mean to the plant pathologist that a particular fungus is probably present. This is then confirmed either by examination under a microscope, or by making pure cultures. Some of the fungi, it is true, grow so luxuriantly on the outside of the plant or fruit, as, for example, the cottony fungus, that they can be easily seen

with the unaided eye. But this is not true of many, and is only true of the few in their advanced stages of growth.

While the importance of protection against fungous diseases is recognized and has been felt, and is being felt more and more keenly by the quarantine officers, the larger emphasis has been and still is put on the insects. The development of quarantine and control of insects naturally came first. The law requires all quarantine officers and county commissioners to be skilled entomologists, but says nothing as to their qualifications to recognize an injurious fungous or bacterial disease. Of course, certain more obvious diseases, such as crown gall, pear blight or canker of fruit trees are easily detected, and the quarantine officers and horticultural commissioners have been guarding against the spread of such troubles for a long time.

A dangerous and destructive fungous pest that would mean inestimable loss to the agricultural interests, however, might get into the State from some other country. Fungous diseases are known in tropical and semi-tropical countries, that make the growing of certain crops almost impossible. Diseases of citrus trees are known to the writer in Florida, which if they developed as well in California, their introduction would mean many thousands of dollars loss. They would probably not do so much damage here as in Florida, but this we do not know, and do not care to incur the danger of trying to find out. The "Stem-end Rot," the "Diplodia Gumming," and "Florida Scaly Bark," are three destructive Florida fungous diseases not known in this State. While we are not likely to get them direct, because of the strict quarantine against all products from Florida, yet they may come in from some other countries.

The Diplodia fungus is known to occur in South Africa, as well as in Florida, and attacks peach trees as well as citrus (see article on Gum Diseases of Citrus in the April number).

In connection with the interest in a national quarantine law as shown by the discussions of the original Simmons' bill, fungous as well as insect pests are included. The danger to this country from the further introduction and spread of the White Pine Blister rust and the potato wart disease, both due to fungous parasites, is keenly felt. A new Cedar Apple fungus has been discovered in Connecticut on imported Japanese cedar. In Japan this fungus has a stage of growth on the Japanese pears and quinces that is quite seriously threatening the industry of an entire province of Japan.

The question naturally arises, how could quarantine against fungous pests be made more effective? If these fungi are so small and obscure and hard to detect, how are we going to keep the diseases out? There are, of course, difficulties in the way, as in case of insects, but as was pointed out, nearly all destructive fungous diseases produce certain effects by which they can be known to be present in a destructive form. It would seem advisable to the writer to so strengthen the quarantine law as to provide for a man on the force to be added to the quarantine at each port of entry, especially skilled in detection of plant diseases:

one that would have his eyes peeled primarily for those kinds of things, and who would keep himself informed of especially destructive diseases that are known in other countries or states, but not yet found in this country or this state. In some cases it might even be advisable to quarantine against certain definite plants or fruits in a certain definite country or state known to be infected with a threatening fungus disease, just as we do now for insect pests. The high efficiency and workings of the quarantine against insects have taken time to develop to its present place. Quarantine against insects came first, because the insects were first known. With the advent of better knowledge of fungous diseases ought this phase of quarantine be allowed to lag behind or should it not be developed along with the quarantine for insects?

THE APRIL CROP REPORT.

By G. E. Merrill.

The outlook for an excellent crop of the various deciduous fruits continues encouraging, except that some reports of an extensive drop of plums and prunes have been received. This drop is perhaps due to a lack of sufficient moisture, a factor in the maturing of the season's crop that will become more important as the season advances.

A brief résumé of the present conditions of the more important deciduous fruits is given herewith:

This summary was derived from the monthly reports of the county horticultural commissioners.

Almonds.—The present indications are that almonds will be from 50 to 100 per cent larger than last year's crop.

Apples.—In the majority of counties, the apple crop promises to be larger than last year.

Apricots.—The apricot situation seems to have improved since last month. Last year's crop will probably be equaled or exceeded.

Cherries.—Early shipments are now being made, and this year will probably equal or exceed last year's.

Grapes.—The grape outlook still continues good, except that some frost damage has been noticed.

Peaches and Pears.—All indications, except a possible lack of moisture, point to an excellent crop of both peaches and pears.

Plums.—Considerable complaint has been received that Japanese plums have not set well. Other varieties promise well.

Prunes.—Complaints of a heavy drop have been noted, but the outlook for a large crop is still good.

GENERAL NOTES.

AN INTERESTING AND SUGGESTIVE DISCOVERY.

Bacteria are strangely, fascinatingly and exceedingly mysterious. So minute are they that they are only visible upon extreme magnification, often so virulent that they mow down whole communities of men and the lower animals as grain falls before the reaper; often so helpful that success in agriculture hangs on their presence and activity; always obscure and difficult of discovery and study.

One, *Bacillus coli*, so named as it is nearly if not always present in the lower bowel—colon—of man and many of the lower animals; was discovered only twenty-seven years ago; is rod-shaped, often very short, looking like a ball, one end usually slightly enlarged, and always

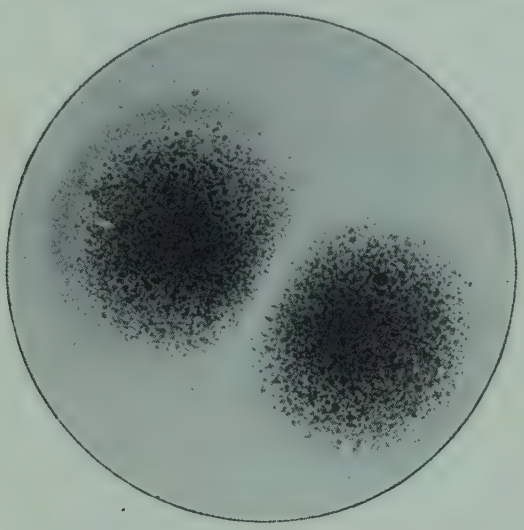

FIG. 97.—Colonies of colon bacilli from human slightly magnified. (Park and Williams.)

nonspore-bearing. It is from one twenty-five thousandths to three twenty-five thousandths of an inch in length. It is usually benign, but may be pathogenic. It is very slightly motile, and has a few short lashes—flagella. It very much resembles the typhoid bacillus—*B. typhosus*. This latter is a little smaller, carries more flagella and is quite motile. These two micro-organisms differ most in their effects, but act differently in cultures, vary in color, and are really distinct species.

THE COCOANUT BUD ROT.

This is a serious malady of the cocoanut palm. It is prevalent in Cuba and the adjacent islands and the nearby coast regions, also in other tropical climes. The disease is said to be well named "Bud Rot" as the terminal buds of the growing shoots are affected with a mushy rot, which is attended with a disgusting odor. Soon all the new growth

is affected, the leaves turn yellow and the nuts fall. The pendant leaves give a dolorous look to the trees, which usually collapse in from two months to a year's time. It often lessens the profits tenfold.

A WONDERFUL DISCOVERY.

Mr. John R. Johnston (see Bulletin No. 228, Bureau of Plant Industry, U. S. Department of Agriculture) has determined that this bud affection is caused by a bacillus, and strange to say, seems to have proved that the specific germ that has caused it is our ever companion *Bacillus coli*. The rank odor would suggest that the cause of the disease is bacterial. Mr. Johnston isolated the specific germ and induced the disease by inoculation. He also believes that birds and insects carry the germs and thus explains the rapid spread of the disease. Turkey buzzards frequent the trees and are thought to be attracted by the vile smell. The germs are found in the droppings of these birds, and they react as do the bud rot bacilli. The remarkable discovery that the *Bacillus coli* of our own intestines is identical with the bud rot bacillus is most significant. If it can so change its habits, rendezvous and mischievous work, why may not other bacilli do the same?

Surely we are most fortunate that we in California are to have the services of one of the best mycologists of the country, who will work largely in the field, and thus supplement the able researches of the men who are doing such admirable work in our own State University.

The word ecology is new, but is worth a deal as is what it stands for. The ecology of a plant or animal is its relation to its environment, thus the ecology of the *Bacillus coli* is most interesting. We furnish it a home in our own person, but now share the privilege with the cocoanut palm. We would not mourn if it utterly forgot its old domicile in the enjoyment of its new habitation. Such a history as Mr. Johnston has given us promises great and valuable results for the future, and makes us more appreciative of work, study and research in the realms of these infinitesimal organisms.—A. J. Cook.

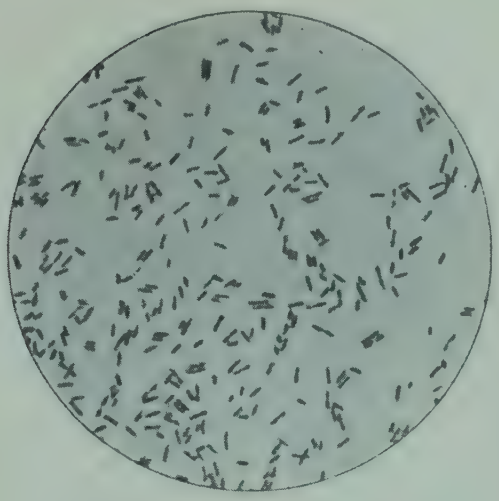

FIG. 98.—Colon bacilli (*Bacillus coli*) from human. Twenty-four-hour agar culture. (Park and Williams.)

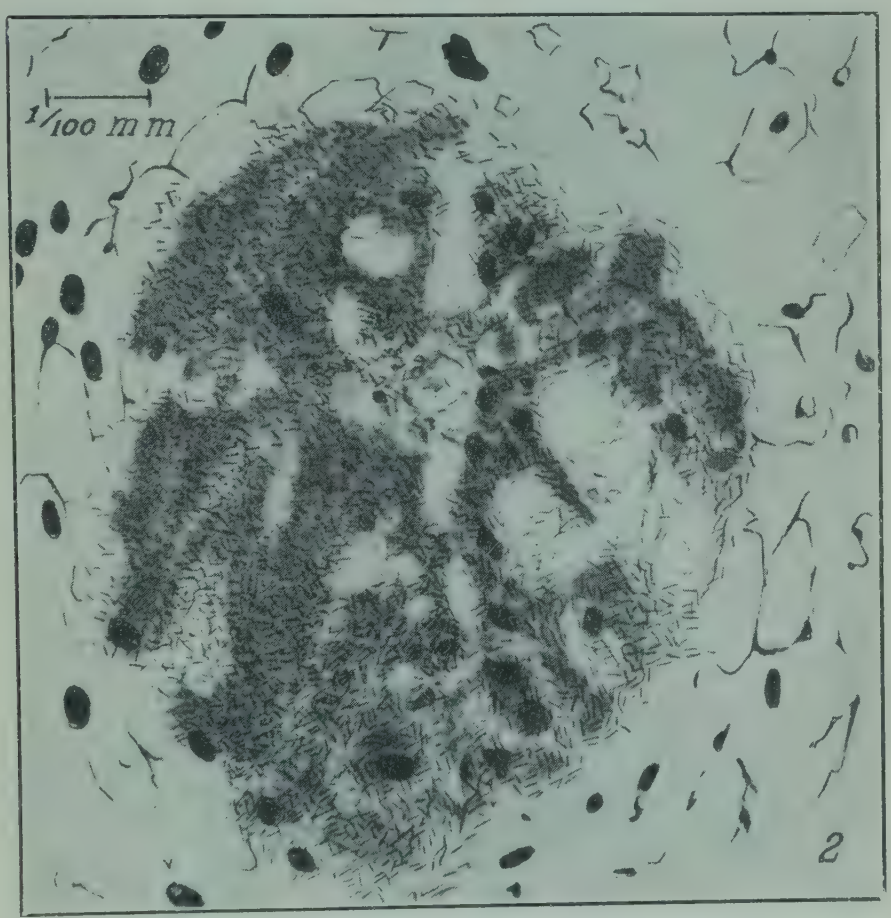

FIG. 99.—Colon bacilli from midribs of a cocoanut palm leaflet. (U. S. Dept. Agrcl.)

NATIONAL QUARANTINE LAW.

A large number of fruit growers and horticultural officials are justly interested in the National quarantine law, and this interest warrants some acquaintance with the present efforts to pass such a law.

There are now several bills before Congress providing legislation along this line. The bill which has created the most interest during the past years is known as the "Simmons' Bill." In its original form it was seriously objected to by growers and entomologists because it did not carry provisions for the inspection of nursery stock at the ports of entry, and the establishing of quarantine against foreign localities known to harbor dangerous insect pests or plant diseases (see "Monthly Bulletin," Vol. 1, No. 1, p. 23).

A general movement was begun early this year to add these provisions to the final bill, and thus make it satisfactory to those who were not in favor of the original bill. The State Commissioner of Horticulture, Dr. Cook, began active correspondence with members of the U. S. Department of Agriculture and with the California Senators and Representatives at Washington, D. C. He also brought the matter before the agricultural committees of the California legislature, and succeeded in interesting the law-making body of this State to the extent that a joint senate and assembly resolution was passed favoring National quarantine (see "Monthly Bulletin," Vol. 1, No. 2, p. 50). Copies of this resolution were transmitted to the President and Speaker, respectively, of the Senate and House of Representatives of the Congress of the United States, and to each of our Senators and Representatives in Congress. Prominent fruit growers also took active part in the campaign. James Mills, of Riverside, made a special trip to Washington and did a rare service for California. The Congressmen of California have taken a very active part in drafting and supporting a suitable quarantine law. On April 16, 1912, Mr. Raker introduced a bill (H. R. 23413) which is in many respects superior to anything that has been produced. One thing which is of special interest to California is the provision for the inspection and fumigation of foreign nursery stock at Nogales, and El Paso. However, the bill does not provide for the inspection of foreign nursery stock at other ports of entry. In other respects the bill is practically the same as the preceding one.

To the mind of the writer the bill introduced in the House of Representatives on April 1, 1912 (H. R. 22728) is by far the best bill which we have had the privilege of reviewing for some time. This bill provides for the inspection of foreign nursery stock at the ports of entry, or before it is shipped from one state, district or territory to another state, district or territory within the United States. The bill is of special interest to Californians in that it places an immediate quarantine on all foreign sections known to be infested with the Mediterranean fruit fly. The sections containing the above are hereby presented in full.

> SEC. 2. That it shall be the duty of the Secretary of the Treasury promptly to notify the Secretary of Agriculture of the

arrival of any nursery stock at port of entry; that the person receiving such stock at port of entry shall, immediately upon entry and before such stock is delivered for shipment or removed from the port of entry, advise the Secretary of Agriculture or, in his discretion, the proper state, territorial, or district official of the state or territory or the district to which such nursery stock is destined, or both, as the Secretary of Agriculture may elect, of the name and address of the consignee, the nature and quantity of the stock it is proposed to ship, and the country and locality where the same was grown. That no person shall ship or offer for shipment from one state or territory or district of the United States into any other state or territory or district, any nursery stock imported into the United States without notifying the Secretary of Agriculture or, in his discretion, the proper state, territorial, or district official of the state or territory or district to which said nursery stock is destined, or both, as the Secretary of Agriculture may elect, immediately upon the delivery of the said stock for shipment, of the name and address of the consignee, of the nature and quantity of stock it is proposed to ship, and the country and locality where the same was grown, unless and until such imported stock has been inspected by the proper official of a state, territory, or district of the United States.

SEC. 7. That whenever, in order to prevent the introduction into the United States of any tree, plant, or fruit disease or of any injurious insect, new to or not theretofore widely prevalent or distributed within and throughout the United States, the Secretary of Agriculture shall determine that it is necessary to forbid the importation into the United States of any class of nursery stock or of any other class of plants, fruits, vegetables, roots, bulbs, seeds, or other plant products from a country or locality where such disease or insect infestation exists, he shall promulgate such determination, specifying the country and locality and the class of nursery stock or other class of plants, fruits, vegetables, roots, bulbs, seeds, or other plant products which, in his opinion, shall be excluded. Following the promulgation of such determination by the Secretary of Agriculture, and until the withdrawal of the said promulgation by him, the importation of the class of nursery stock or of other class of plants, fruits, vegetables, roots, bulbs, seeds or other plant products specified in the said promulgation from the country and locality therein named, regardless of the use for which the same is intended, is hereby prohibited; and until the withdrawal of the said promulgation by the Secretary of Agriculture, and notwithstanding that such class of nursery stock, or other class of plants, fruits, vegetables, roots, bulbs, seeds, or other plant products be accompanied by a certificate of inspection from the country of importation, no person shall import or offer for entry into the United States from any country or locality specified in such pro-

mulgation, any of the class of nursery stock or of other class of plants, fruits, vegetables, roots, bulbs, seeds, or other plant products named therein, regardless of the use for which the same is intended: *Provided*, That before the Secretary of Agriculture shall promulgate his determination that it is necessary to forbid the importation into the United States of the articles named in this section he shall, after due notice to interested parties, give a public hearing, under such rules and regulations as he shall prescribe, at which hearing any interested party may appear and be heard, whether in person or by attorney: *Provided, further*, That the quarantine provisions of this section, as applying to the white pine blister rust, potato wart, and the Mediterranean fruit fly, shall become and be effective upon the passage of this act.

Certainly this bill as it now stands is of the highest order, and should receive every encouragement.

In considering the passage of the National quarantine law we must not overlook the efforts which are being made by the various associations of nurserymen throughout the United States. Due to their efforts several compromised features have entered which were not at all satisfactory to many of the legislators. But in order to assure the passage of a bill at all during this session of Congress it has often been deemed advisable to accept such compromises on the ground that it is better to have a national bill, though limited in scope, rather than no national protection at all. In such cases we do not wish to appear to be overcritical; but if we can obtain the desired measure we believe that the whole country will be saved millions of dollars. All parties interested in the matter should not hesitate to make their desires known to the lawmakers at the national capital, because their acts are largely influenced by the wishes of the people.—E. O. Essig.

WHITE FLY FUMIGATION IN MARYSVILLE.

Early in April a cursory inspection by Mr. Fawcett and the writer showed that living larvæ of the white fly could be found in the infested district in Marysville. Enough was learned at this glimpse of the situation to warrant a more careful examination. About a week later, Mr. Branigan and the writer made a systematic search over practically all of the district in which the pest had ever been found. The presence of the insect at this time was demonstrated on the citrus trees on fifteen pieces of property. The intensity of the infestations varied from a few very scattered individuals to as many as 30 to 40 on single leaves from the most badly infested trees. A large proportion, probably three fourths, of all the insects discovered were dead, either from natural causes or from the effects of the caustic soda-distillate oil spray applied last fall. In the greater number of cases considerable search was necessary to discover the insect.

In view of the situation as outlined in the foregoing, the State Commission of Horticulture decided that an immediate reduction of the chances of a general spread of the insect would be desirable, even though it was not the best season of the year for an eradication campaign. Fumigation of the infested trees seemed to be the most expedient method of meeting the situation. Accordingly the cooperation of Yuba County was secured through Mr. G. W. Harney, the Horticultural Commissioner, and on April 15th the work was begun. As the time was short before the fly would be in the pupa and adult stages the control measures were carried on as rapidly as possible. By April 25th all the citrus trees on the infested lots had been fumigated, as well as those on four other pieces of property in the immediate vicinity of the most badly infested trees.

The regular purple scale dosage was used except on those trees on which the pest was actually known to be present. In such cases the dose was increased about a quarter. Considerable foliage injury was noted on trees with a large amount of new growth. On other less advanced trees little if any injury could be detected, even with the heavier dosage. The degree of success attending the work will, of course, be apparent during the coming season. There is good reason now to believe that there will be less of the pest present this year than last.—G. E. Merrill.

NOTES FROM THE COUNTY COMMISSIONERS.

Humboldt.—Commissioner Weatherby has informed us that he plans to visit the State Commission early in May.

Madera.—Large nursery plantings are being made this year in Madera County, according to information received from Commissioner Marchbank.

Sacramento.—Messrs. Fawcett and Carnes of the State Commission were recently guests of Commissioner Bloomer and Professor Chase in an oak root fungus inspection tour of Fairoaks and vicinity. They found the disease very much in evidence at the present time.

San Bernardino.—County Commissioner Pease recently intercepted a white fly infested shipment of nursery stock from Mississippi.

Tehama.—Commissioner Weeks reports marked success in control of peach curl leaf and peach bud moth. The orchards of his county are in excellent condition. He also reports fair success in the control of black peach aphis by the use of a combination of the lime-sulphur solution and Blackleaf.

Tulare.—Commissioner Schulz reports large importations of citrus nursery stock for orchard planting this season.

Yuba.—Commissioner Harney has been fumigating for white fly in coöperation with the State Commissioner of Horticulture. The citrus trees on 19 different lots were fumigated. The presence of the pest had been actually demonstrated on 15 of these lots.

EDITORIALS.

EASTERN RATES TO SANTA BARBARA CONVENTION.

Easterners as well as Californians who are interested in horticulture should carefully consider attending the California State Fruit Growers' Convention which is to be held at Santa Barbara, June 12th to 14th. The program of this convention appears in the front. It will be seen that addresses are to be given by men of world-known reputations. The discussions following these papers are by the ablest fruit growers in this State, as well as by state and national horticultural officials.

The railroad companies have offered the following low rates from the East : For return tickets, good until October 31st, any route can be selected with choice of route to return when stopovers permitted : Chicago, $72.50; Kansas City, $60.00; St. Louis, $67.50. Rates from other eastern cities correspondingly low.

PUBLICATIONS ON FROST PROTECTION.

The Citrus Protective League has issued a publication (Circular No. 6) treating of Frost Protection. The circular is by G. Harold Powell, and includes a report by Dr. J. Elliot Coit, superintendent of the Riverside Citrus Experiment Station. It contains a full account of the best known methods of frost fighting and should be in the possession of every citrus grower.

A number of articles have been prepared dealing with frost fighting in deciduous orchards. Some of the most important of these are as follows :

"Prevention of Frost Injury to Fruit Crops," by G. B. Brackett, Yearbook U. S. Dept. of Agriculture for 1909.

"The Protection of the Orchards in the Pacific Northwest from Spring Frosts by Means of Fires and Smudges," by P. J. O'Gara, Farmers' Bull. 401, U. S. Dept. of Agriculture, 1910.

"Orchard Heating," by C. G. Woodbury and J. W. Wellington, Bull. No. 154, Ind. Agrcl. Experiment Station, Oct., 1911.

"The Avoidance and Prevention of Frost," by J. E. Church and S. P. Fergusson, Bull. No. 79, Nev. Agrcl. Exp. Sta., Jan., 1912.

THE MONTHLY BULLETIN.

The State Commission of Horticulture is very much pleased with the many expressions welcoming the Monthly Bulletin. From the first mailing list of 600, the applications have run up until 2,150 are now regularly receiving the publication.

Dr. Cook early took up the mailing question with the postal authorities at Washington and on December 28, 1911, the publication was entered

at the post office at Sacramento as second-class matter. This makes the cost of mailing only about five dollars a month, which means much to the commission.

It is the aim to make it always practical and of use to the growers all over the State, and in doing this it is necessary to cover a wide field. It is not always possible to publish articles in each number which will be of vital importance to every reader, but rather to treat as many phases of horticulture as practicable. The December number of this year will contain a full index of all the numbers issued before that time, so all the readers are urged to preserve the complete yearly issue that it may be bound up in a single edition at the end of the year.

We are greatly indebted to the large number of well trained men who have contributed to make The Monthly Bulletin valuable throughout this State, and trust that we shall be as favored in the future as in the past.

QUARANTINE AT HONOLULU.

Few of the growers in this State realize what is being done in the quarantine work at Honolulu to prevent the entrance of the Mediterranean fruit fly from gaining a foothold in America. Dr. Cook early realized that the work at San Francisco only protected California from shipments direct to that port. What about the ports along the Oregon and Washington coasts where no quarantine is being maintained? Shipments by rail from those states or infestations within them means almost as much to this state as if entered at our own ports.

In consideration of these facts, Mr. Weinland was sent to Honolulu to inspect fruits leaving the islands. He immediately sought the coöperation of the Hawaiian authorities, who are very willing to do all in their power to prevent the spread of the fruit fly, with the result that no infested or questioned fruit is permitted to leave the islands for any port in America. How much does this lessen the dangers? A report from Mr. Weinland for the month of March reveals the following:

That during the month vessels not carrying passengers sailed from Honolulu to the ports of South Bend, Aberdeen, Puget Sound, Port Townsend (2) in Washington; to San Francisco (2) in California. Coast-bound steamers not carrying passengers sailed for Eureka, Gaviota, and San Francisco (2) in California, and to Salina Cruz (2) in Mexico. Sailing vessels from island ports other than Honolulu sailed to Port Townsend (2) and Grays Harbor, Washington, and to San Francisco (3).

All regular passenger vessels between Honolulu and Pacific coast ports are not included in the above, but they receive even more consideration by the inspectors.

This safety alone means much to the state, and is an example of the pains taken by the present State Commissioner to prevent the introduction of Mediterranean fruit fly.

TWO APPLE CANKERS

Due to the fungi Nectria ditissima and Nectria cinnabarina.

By H. S. Fawcett.

The two apple cankers due to the two species of Nectria fungi above mentioned are present in the northern portion of California. These cankers are not usually very serious, but as they are a source of some alarm at times, a report in regard to them may be found useful. Specimens of the European apple canker (*Nectria ditissima*) that had com-

Fig. 101.—Apple canker due to *Nectria ditissima*. (Original.)

pletely girdled limbs an inch or more in diameter, were collected by Mr. E. O. Essig in Humboldt County. Specimens of the same canker collected at two other localities in the same county were found in the Herbarium at the University of California, identified by Miss E. H. Smith and Professor W. T. Horne, respectively. Mention is made of this canker by Professor R. E. Smith in the first report of the Plant

Pathologist, Bulletin 203, of the California Agricultural Experiment Station. Recently a specimen was received from Sonoma County, showing the fungus in an active condition in the beginning of a canker. In the Eastern States this fungus is of common occurrence, causing one of their less serious cankers. In Europe it is reported to be a serious and widespread disease.

The fungus causing this canker is thought to gain entrance at wounds such as hailstone injuries, bruises, or wounds made at the time of pruning. The mycelium penetrates the bark chiefly, but may also extend to the cambium and youngest wood tissue. The bark cracks, forming fissures and rifts resulting in the canker (Fig. 101). There are three

FIG. 102.—Piece of bark from an apple canker showing the red lemon-shaped perithecial bodies of *Nectria ditissima* which have pushed out from the inside tissues. (Original.)

kinds of spores formed. At first the fungous filaments in their growth produce one-celled spores. Later white cushions are formed on the bark, on which are produced spores shaped like a sickle. After the canker becomes older, there push up through the bark, red, lemon-shaped, small bodies large enough to be seen by looking carefully with unaided eye. Figure 102 shows some of these bodies three or four times magnified as they form in rifts in the bark. These contain club-shaped sacks inside of which are a row of the third kind of spores, two-celled, oval, thicker-walled, and more resistent to drying out than the two previously mentioned forms.

A second species of Nectria (*N. cinnabarina*) also occurs on apple trees as well as on a variety of other trees both in Eastern United States

and in England. This fungus was also identified by Miss E. H. Smith on a specimen sent to the University of California from Humboldt County (Fig. 100). This fungus may be distinguished from *N. dilissima* by its bright red, button-shaped, conidial cushions containing ovate instead of sickle-shaped spores, and by the formation of dark red masses of thick-coated, warty instead of smooth, bodies on the dead wood. Just to what extent it injures apple trees in this State is not known.

For both of these cankers the same remedy is applicable. Since the fungus appears to enter at bruises or wounds, the cankers may be prevented by painting the wounds or cuts with pine tar, tree wax, white paint or strong Bordeaux mixture. Cankers already present should be cut out and burned.

SWEET POTATO STEM BORER.

(Omphisa anastomosalis Guen.)

By Frederick Maskew.

The sweet potato stem borer *Omphisa anastomosalis* Guen. is oriental in origin, having been recorded as being more or less general throughout the Indo-Malayan region. So far it has not yet become established

Fig. 103.—Larvæ of the sweet potato stem borer (*Omphisa anastomosalis*). Side view.

in California, but is diligently seeking an entrance. Live larvæ and pupæ from which adults (Fig. 107) have been reared have been repeatedly taken at quarantine in San Francisco, in commercial shipments of sweet potatoes arriving from Honolulu. The infested material, aggregating in the different lots 228 sacks, was promptly returned to the point of shipment. This insect in its larval form is credited with being very destructive to the vines, causing them to wilt and die. Our findings at quarantine show that it is equally destructive to mature potatoes (Fig. 105).

The following succinct account of its life history is taken from Bulletin No. 22, Hawaii Agricultural Experiment Station (David T. Fullaway):

LIFE HISTORY.

There are four stages in the life cycle, as with the other moths—the egg, the larva or borer, pupa, and adult.

The egg.

The eggs are laid singly or two or three together, usually in the crevices on the stems, sometimes on the leaves. They are elliptical (sometimes irregular), flat or moderately rounded, measuring 0.63 by 0.50 by 0.35 mm., pale green, finely reticulated on both surfaces. They hatch within 5 to 6 days of deposition.

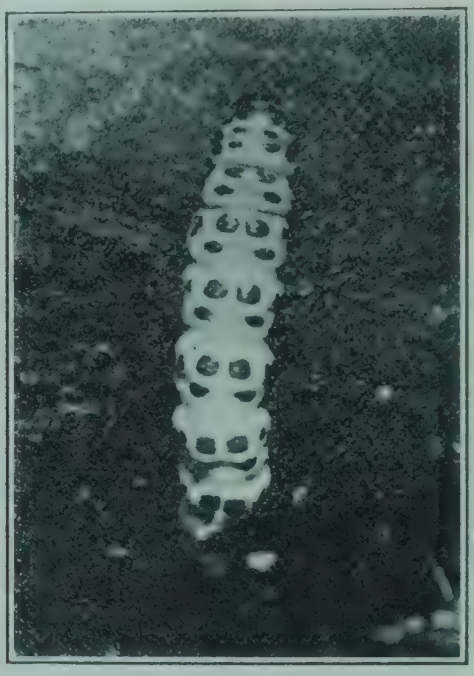

FIG. 104.—Larva of the sweet potato stem borer emerging from a burrow.

The larva (Figs. 103 and 104).

The larva just after hatching is 1 mm. long, sordid white (the contents of the alimentary tract green beneath), head bilobed, black, and a black shield-shaped marking on cervical shield. Hairs conspicuous. Soon after hatching, the larva bores into the stem, a small tuft of ejected material indicating the point of entrance. The larval stage occupies twenty-seven to thirty days, in the course of which several moults are undergone. The full-grown caterpillar is described by Swezey* as follows: "Length about 30 mm., width about 3½ mm., head 2 mm., color pale yellowish white, with conspicuous brown, very broad and flat tubercles; head yellowish brown, ocelli black except the two upper and the lowest one, which are white, mandibles black, a black line on postero-lateral margin of head; dorsal tubercles of two rows begin-

*Proc. Hawaiian Ent. Soc., 1 (1906), pt. 2, p. 76.

ning with segment three, in each row, two per segment except segment four; a row of tiny tubercles, one per segment, just antero-ventral to each of the anterior dorsal tubercles in segments five to twelve; the spiracles of segments five to twelve have a group of four tubercles surrounding each; by their union on some segments there are but three of

FIG. 105.—Sweet potato showing burrows made by the stem borer and a larva *in situ*.

these; a similar cluster of tubercles occupies the position corresponding to spiracle on segments three and four; a line of tubercles just dorsal of the base of the feet; four ventral tubercles on segments 5, 6, 11, 12 (those segments having no feet); the ventral tubercles have two or three hairs, others mostly but one, a few hairs on the head also."

The pupa (Fig. 106).

Pupation takes place in the stem near an exit from the burrow. The pupa is found in a slender web-like cocoon. It is described as follows: "16 mm. long and 3 mm. wide, nearly cylindrical, abruptly tapering at the posterior segments; uniform medium brown, a slightly darker band on posterior margin of abdominal segments; tiny short hairs where there were hairs on the larva; wing-cases a little pointed, extending to posterior margin of fourth abdominal segment, one pair of leg-cases extends a little farther, about half-way on the fifth segment; cremaster

very short, blunt, with a few hooked spines." The pupal period is sixteen to eighteen days.

FIG. 106.—Section removed from a sweet potato to show pupa of the stem borer in an old burrow. The frass from the burrow is plainly visible at the bottom.

The adult (Fig. 107).

The following is a description of the moth*:

White; the head, thorax, and abdomen suffused with ochreous and rufous, leaving some paired pale spots on dorsum. Forewings with rufous suffusion on basal area extending below median nervure to middle of wing; hyaline patches at middle and end of cell, with rufous-edged ochreous spot between them; a large rufous-edged ochreous patch beyond the cell; the outer area more or less irrorated and suffused with rufous; the veins rufous; a curved post-medial rufous line with an irregularly dentate line beyond

*Hampson, Moths. Fauna British India, vol. 4, p. 382 (fig. 207). London, 1896.

it enclosing a series of hyaline patches; a marginal rufous line. Hind-wing with the base rufous; a dark-edged rufous irregular discocellular mark with line from it to inner margin; the outer area irrorated with rufous; two irregularly waved rufous postmedial lines; the apex, anal angle, and a marginal line rufous. Expanse 32–36 millim."

From the foregoing it will be seen that there is but little hope of relief from the application of remedies in localities where this pest has become established. During its most vulnerable life stage it works in secret, protected from interference by the tissues of the plant it has

FIG. 107.—Adult female of the sweet potato stem borer (*Omphisa anastomosalis*).

attacked. Those who by reason of experience in dealing with this pest are the most competent to advise, offer as the only practical course to pursue, a complete change of location. When a locality, as a result of superior conditions of certain plant requirements, has become accepted and fixed as a trade name representing a standard of excellence for that crop, it would be disastrous either to be compelled to move away, or have the market value of the crop ruined by the appearance or work of a pest. The work of this insect upon the mature potatoes (Fig. 105) is very insidious and not to be detected until the same are cut open. To us at quarantine the ultimate results of the work of this pest appeared to extend to much greater lengths than the mere destruction of a small percentage of the crop, and consequently we denied admittance to the infected material.

These photographs were made by E. O. Essig from specimens taken in quarantine, which were furnished by the author.

THE TREATMENT OF WOUNDS AND CAVITIES IN TREES AND SHRUBS.

By W. Vortriede, Head Gardener, Capitol Park, Sacramento, California.

Although horticulturists, foresters and landscape gardeners have had sufficient knowledge for many generations to treat wounded trees suc-

Fig. 108.—Cavity of a large street elm tree filled with concrete. The filling extends from the lower limbs to the roots. (Essig.)

cessfully, and although the love for large old trees seems to be inherited by all mankind; it is only within the last twenty years or so that we have commenced to do more for the welfare of our arboreal friends.

Trees in private and public parks were usually well taken care of with few exceptions. The pruning was done carefully. Large limbs were sawed correctly: no stubs left to disfigure the main trunk and the wounds thoroughly painted with coal tar to prevent rot. Hollow trunks of valuable old trees were filled and strengthened with brickwork and closed with mortar, and so the lives of the trees saved for many years to come. But not so the street shade trees of towns and cities. These trees were mostly well planted and taken care of in

FIG. 109.—A very large cavity near the base of a pine tree filled with several tons of concrete. The opening shown is only a small portion of the cavity. (Essig.)

former years. The adjoining lot owner did this work mostly himself, or he saw that the work was properly done. The present-day commercialism was not pressing on his valuable time as now. He had more time to look after his home. The streets did not have an entirely waterproof pavement and the rains could penetrate and give the necessary moisture to the roots of the trees. Under such favorable con-

ditions the trees were usually healthy and outgrew small accidental wounds very soon with little help.

All this has changed. The modern city streets have a waterproof surface. Rain or irrigating water cannot find passage below except by special provision for it, which is hardly ever made. Our street

FIG. 110.—A concrete filling in an acacia tree. Portions of this tree were badly decayed and its life was threatened. It is now perfectly sound and healthy. (Essig.)

trees begin to show ill effects and in their best years look sickly. Insects and fungi seem to thrive on them. The callousing of wounds is slower under such unfavorable conditions. The tree pruners neglect their work or do not know how to do it correctly, as shown by the appearance

of the trees. Large accidental wounds are not properly treated. The attacks of insects and fungi soon cause decay.

If the wound is fresh and the wood only slightly injured, prompt aid may heal it in one year. All ragged tears must be cut smooth, the wound then painted with Bordeaux or carbolineum, and completely covered with a tree-wax or putty made out of one part of coal tar and four parts of ground slate. If trees have been badly neglected, large limbs broken off, the wounds not properly treated, the stubs of large limbs or branches left instead of smooth cuts to the trunks or limbs, and rot has set in; then the stubs must be cut smooth to the trunks or limbs, all decay chiseled out, and the cavities filled with concrete made of one part Portland cement and two or three parts of sharp, coarse sand or fine rubble.

Street shade trees often have large, old wounds near the ground (Fig. 109). In such cases the exposed wood should be thoroughly examined, for sometimes a hard shell harbors entirely dry, rotten wood beneath it. All unsound wood should be chiseled out, which often leaves nothing but an outer shell of sapwood and bark. If the tree is old and large and the whole inner root rotted away, it is best to drive three one inch iron pipes inside the cavity of the tree well into the ground—say three feet deep—and fill the hole with a strong concrete of one part Portland cement and five or six parts of coarse rubble. After this has set it should be smoothed off with a finer concrete of two parts of sand and one part of cement.

If the tree is vigorous enough to callous over in a few years, the concrete should only come even with the cambium layer. Where the tree is old, and the wound very large—say half the circumference of the tree—then the concrete can be placed to conform with the outside curve of the trunk, but the edge must be looked after every year and chiseled away if the growing rim of the tree wound presses too hard against it. All injuries will try to heal over, even though very slowly.

Every wound or cavity should be painted or sprayed with a strong Bordeaux mixture or carbolic acid emulsion before filling with concrete. The filling should be painted the color of the tree bark. Large cavities often take a ton or even several tons of concrete.

This work pays well, especially along streets where a lost tree is so difficult to replace, and where symmetry counts for so much (Fig. 108). Many trees suffer when comparatively young from the decay of the heart or pithwood near the foot, and this decay slowly affects the adjoining wood layers, and will sooner or later show on the outside. As soon as this defect is known, an opening should be made into the tree so as to work out all decayed wood and replace it with concrete.

SEED TESTING.

By E. J. Newcomer.

Every one who has planted seeds of any kind, knows that very often all do not grow, and many are not true to name.

A number of years ago the United States Bureau of Plant Industry gathered together nearly three thousand packets of vegetable seeds, from eight states, put up by twenty-seven different seed growers, and representing twenty-six garden vegetables—beans, carrots, lettuce, peas, onions, turnips, watermelons, cress, etc. The germination of all these seeds was tested, that is, a certain number was counted out from each packet and kept under proper conditions of moisture and temperature, and the per cent that grew was recorded. These tests showed that the average germination was about 62 per cent, or that less than two thirds of the seeds grew. About sixty packets of seed failed to grow entirely. The germination of the entire lot ranged from 0 per cent to 100 per cent. From this it may be seen that the seed we buy is sometimes practically or entirely worthless, due to poor quality, extreme age or some other cause.

Garden seeds are in most cases true to name, as there is little opportunity for accidental or intentional adulteration. But with other seeds, particularly those of the various kinds of clover, weed seeds are usually present, and the cheaper grades may be purposely adulterated. When a demand for cheap seed arises, it may be met by some dealers by mixing in worthless seed, or seed of some other plant, or even particles of quartz. It is undoubtedly cheaper in the end to buy the best seed, for in buying cheap seed, one not only has to handle considerable worthless material, but he runs the risk of introducing harmful weeds into his land, and the actual cost of the pure seed that will grow is often higher. Take the example given in one of the government bulletins. A farmer pays twelve dollars a hundredweight for his alfalfa seed, when the best seed is selling at fifteen dollars. In order to lower the price, the dealer has adulterated this seed, but he has also gone farther, and made some extra money from it. He has mixed a hundred pounds of good seed, worth fifteen dollars, with a hundred pounds of bad seed worth two dollars. Thus, the two hundred pounds are worth seventeen dollars, but he sells them for twenty-four dollars. The farmer, buying this mixture at twelve dollars a hundredweight, thinks he is making a better bargain than if he paid fifteen dollars, but in reality he is getting only a hundred pounds of good seed, worth fifteen dollars, and a hundred pounds of bad seed, which is worth nothing to him, but for which he pays the difference between twenty-four dollars and fifteen dollars, or nine dollars.

Because seed is sometimes adulterated, or may contain noxious weed seeds, or may be so old that it will not grow, it is advisable to test or have it all tested before it is bought. An experienced farmer can usually tell if the seed is old or if it contains much dodder, by an

examination of it, but some of the adulterants are so very much like the seed they are mixed with, that it is practically impossible to tell the difference without a good lens and a knowledge of the different kinds of seeds. Following Professor Cook's suggestion, I have been studying clover seeds for some time, and making tests of samples. I have found no evidences of adulteration, but some of the seed contained considerable weed seed, and old seed that would not grow.

The following table shows the results of the tests of five samples, two of alfalfa, and one each of red, alsike and white clover:

Sample.	Per cent of pure seed.	Per cent of other seed.	Per cent of dirt, sand, stems, etc.	Per cent of pure seed that will grow.	Per cent of total seed that will produce plants true to name.
No. 1 (alfalfa)	67.27	18.16	14.54	64	43
No. 2 (alfalfa)	98.47	0.55	0.98	68	67
No. 3 (red clover)	95.40	1.10	3.50	77	73
No. 4 (alsike)	98.07	1.28	0.51	66	65
No. 5 (white clover)	83.60	12.50	3.90	67	56

It will be seen that two tests are made. The seed is first tested for purity. A small quantity of well-mixed seed is taken from the sample, and separated into three piles, one containing only pure seed, a second all other seed, and a third everything else, such as grains of sand, pieces of stem, husks, etc. Then each pile is weighed, and the relative amount of each computed, as shown in the first three columns of the table. Then the amount of viable seed (seed that will grow) is ascertained. A given number, usually 100, of pure seeds are counted out just as they come, whether plump or shriveled, and these are kept in a warm, moist place for a week or ten days. The seeds that sprout are carefully counted, and the per cent computed. This is given in the fourth column. The terms purity and viability must not be confused. Pure seed is the seed that is true to name, while viable seed is the (pure) seed that will grow. Sample No. 1, for instance, contains 67.27 per cent of pure seed; that is, 67.27 per cent of its total weight is alfalfa seed. Sixty-four per cent of this pure seed will grow. The weed seeds are not considered here, as the ultimate purpose of the test is to show what per cent of the seed will produce alfalfa plants. Thus, if 64 per cent of the alfalfa seed will grow, and the sample contains only 67.27 per cent of alfalfa seed, the per cent of the seed that will produce alfalfa plants will be only 64 per cent of 67.27 per cent, or about 43 per cent. This per cent is given in the last column of the table, and is only approximate, as the purity is tested by weight and the viability is tested by count, but it shows graphically how much alfalfa can be expected from this seed.

Included in the purity test is the identification of the weed seeds, a matter of considerable importance. In sample No. 1 over 9 per cent, or about half the total weed seeds, was dodder seed. This alone would cause the seed from which this sample was taken to be immediately

rejected. The other half were seeds of ten or twelve different weeds, mostly two or three kinds of tumble weeds. In sample No. 5 of white clover a large amount of weed seeds (12.5 per cent) was found. Seeds of no less than twenty-five different plants were identified, including sorrel, alsike clover, rib-grass (or buckhorn), three kinds of chickweed, lamb's-quarters, mustard and self-heal. Some of these weeds are of very small importance, while others are extremely harmful and troublesome.

The very best clover seed has a purity of 98 to 99 per cent, and a viability of 97 to 99 per cent. Hard seed is often present in new seed, which considerably lowers the viability, as this hard seed, while it would probably grow if given enough time, sprouts so slowly that it is of little value. It is for this reason that the viability of the samples, except No. 1, is so low. These contained from 18 to 25 per cent of hard seed. The government has published a table giving per cents of purity and viability for various seeds, which it recommends as standards. Part of this table is given below:

Seed.	Purity.	Viability.
Alfalfa	98 per cent	85 per cent
Alsike clover	95 per cent	75 per cent
Red clover	98 per cent	85 per cent
White clover	95 per cent	75 per cent

Seed showing a lower per cent of purity or viability, or both, should be rejected. Seed testing as high as the per cent given is satisfactory unless the 2 to 5 per cent of impurities allowed contain dodder or other noxious weeds.

There are a number of things that a farmer should know about the seed he intends to plant before buying it. He should be sure it contains no dodder seed, for dodder is very troublesome and hard to get rid of. There are other weeds also which are more easily kept out than fought afterwards. He should know whether the seed is adulterated or not; for when he plants alfalfa seed, he wants to get alfalfa and not a mixture of alfalfa and bur clover, or something else. He should know the viability of the seed, for if seed with poor viability is sown no thicker than good seed, he will get a thin stand of the crop. Above all, he wants to know whether the seed is worth what he is paying for it. If he pays a good price, he does not want a liberal quantity of weed seed, dead seed, sand, sticks and stones mixed in. These all add weight and bulk, but are worth nothing. It is even worth something to be without the first.

We are prepared to make both purity and viability tests of any kind of clover seed free of charge. A sample of about two ounces is sufficient for a test. Small quantities should be taken from the top, sides and bottom of the bag, unless the seed is well mixed, as it is imperative that a fair representation of the seed be obtained in the

sample. Samples should be sent in strong boxes, securely wrapped to prevent the seed from escaping, and addressed to the State Insectary, Capitol Park, Sacramento. The following information should accompany the sample, if possible: Name of seed, cost, where produced, of whom purchased, and name and address of sender. We will give information as to per cent of purity, presence of noxious weed seeds and per cent of viability. We can furnish the results of the purity tests within a few days after receiving the sample, depending on the amount of work we have to do; while if a viability test is desired two weeks must be allowed.

We make tests only for farmers intending to purchase seed for their own use. They should get samples of the dealer before buying the seed, and have him agree to furnish the same seed in bulk later, if it proves to be of good quality. We cannot issue certificates to dealers showing the quality of their seed, as it is impossible for purchasers to know whether the seed they buy is the same as that tested, and there is no law in this State covering the matter.

Later it is proposed to take up the testing of other kinds of seeds. We expect also from time to time to publish articles in the Bulletin on the various noxious weeds, with drawings and descriptions of them and their seeds, and methods of eradication when once established.

THE MEDITERRANEAN FRUIT FLY AND HAWAII.

By H. A. Weinland, Honolulu, Hawaii.

There is probably no pest threatening greater menace, and consequently of more interest to California fruit growers, than the Mediterranean fruit fly (*Ceratitis capitata*), which at present is puzzling the horticulturists of several countries.

Of the pests in California, perhaps the codling moth (*Carpocapsa pomonella*) of the apple most nearly resembles this pest, in the fact that the flesh of the fruit is the part affected. Yet compared to this and other insects its work is fearful. We have pests of the leaf, the bark, bud, and root, but this pest of the fruit stands far above all in its destructiveness. Where apples attacked by the moth are reduced in value for sale or use, fruit with maggots in it is utterly worthless. To use the old conundrum—what is worse than finding a worm in an apple?—the answer should be, finding a dozen writhing, wriggling maggots in an orange or other fruit.

Its history I shall not dwell upon except to say that by some means it has traveled from its home, where its natural enemies kept it in check, to South Africa, Australia, and the Hawaiian Islands, leaving behind these checks to its ravages. Sufficient is it to say that it was first known in Hawaii in the summer of 1910, and in the interval to date has extended its ravages to all but one of the five important islands of the group.

To understand the situation, it is necessary to state that the islands

of this group cover some 6,300 square miles, stretching in a chain for some 250 miles. They have all varieties of climate ranging from the rainy, windward slopes, where it rains as much as three inches an hour at times, to the leeward slopes which are almost arid, and from the warm, tropical jungles below 1,000 feet to the snow-capped peaks of extinct volcanoes as high as 10,000 feet.

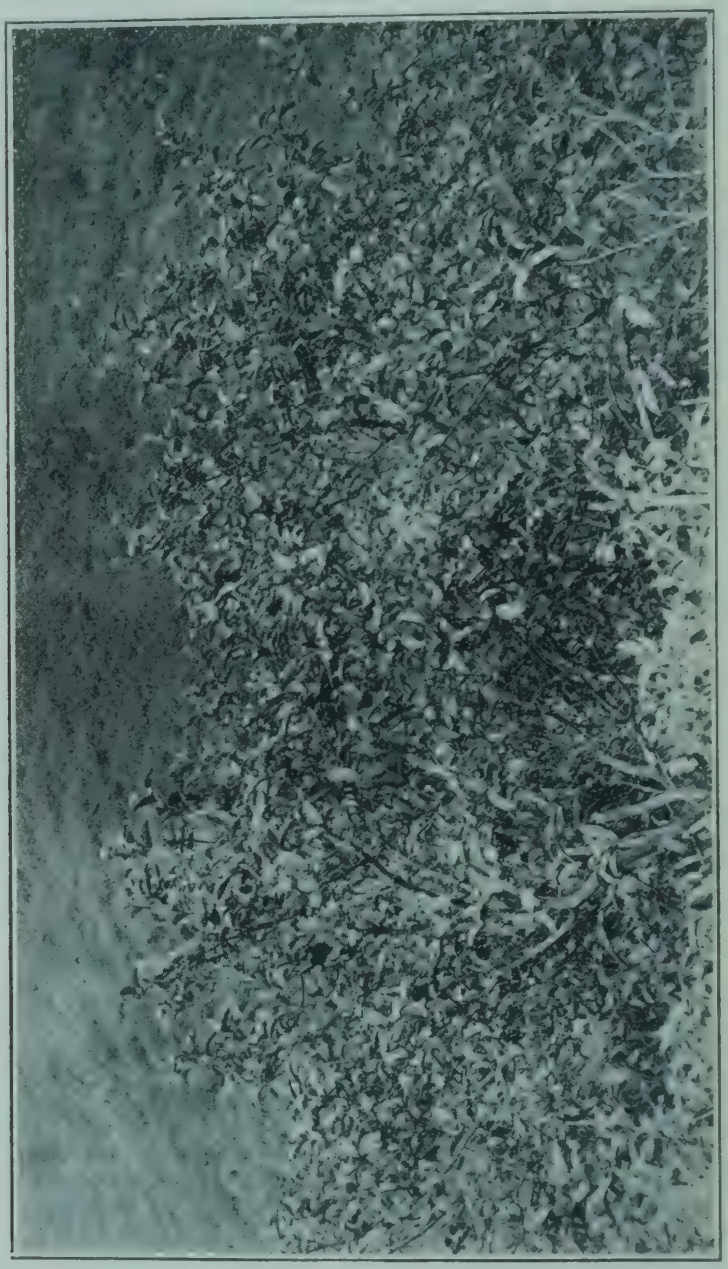

FIG. 111.—Wild guava bushes which cover thousands of square miles of mountainous and inaccessible territory of the Islands. Fruit is produced almost throughout the entire year, furnishing a continual supply of food for the fruit fly. (Original.)

The original inhabitants reaped an easy living from the native fruits and the root of the taro, which grows almost untended. When the white men came they obtained by purchase, grants and intermarriage with the natives, large tracts and areas of land, and sugar became the principal crop and source of revenue. It is safe to say that 90 per cent of the industries of the islands are centered about the growing and

exporting of sugar. The banana, pineapple and rice industries are but small compared with it, yet they are increasing rapidly in extent and importance. Outside of these the islands may be said to have no other industries.

As the sugar industry grew, the ports became of more importance, and we have Honolulu, a city of 50,000 inhabitants, and Hilo of 7,500,

FIG. 112.—Wild guavas on the ground under the bushes one half mile from Honolulu. Some of the fruits were found to be infested with maggots of the fruit fly. (Original.)

besides a few others of lesser importance. Situated, as they are, on a disintegrated lava flow, between crater and sea, in a semitropical climate where something grows everywhere but in the streets, the cities are by the very nature of things, residential and commercial centers combined. The old Hawaiians were accustomed to have plenty of room, and the white people who followed them were not averse to the custom;

consequently, the ordinary home lot is spacious and full of fruits and trees of the country (Fig. 113). In the uncultivated sections will be found much native and some introduced growth. Of greatest importance among the wild fruits is the guava, which covers an immeasurable number of acres. This wild fruit forms a very important food product for the natives and is much enjoyed by others (Figs. 111 and 112).

Into this environment the Mediterranean fly was in some unknown way introduced. The climate was suited to its growth; there was plenty of fruit about, and through prolific reproduction it soon took a lasting hold. When discovered, it had become probably quite abundant, and, owing to the lack of known remedies, its ravages were unchecked. As it was not a pest of the sugar, and attacked neither the pineapple, banana nor rice, but only the backyard fruits and those growing wild, very little excitement was felt. When, however, one season had shown what ravages it could make on choice table fruits, and California had put up the bars on all fruits but the banana and pineapple, the authorities determined on an attempt at control.

Since it was to California's interests, and equally so—considering the above conditions—to those of Hawaii to control the pest in its ravages, a joint campaign was entered into, Hawaii beginning in November, 1911, and California entering in February, 1912.

The means of control to be adopted became a problem. All previous experience in other countries, such as Australia and South Africa, pointed to the fact that the pest was exceedingly difficult to combat since no effective parasite was known and no artificial means of control had been found completely satisfactory.

Traps were thought of and tested in all designs and ways, but the only results obtained so far have been through the use of simple traps based on the fact, discovered by a farmer in Australia, that the male flies were attracted by kerosene. Tests have shown that almost equal numbers of male and female flies issue from the fruit, and supposing that wherever male flies are the females are also, this style of trap serves to tell whether there are large or small numbers of flies in a given vicinity. The trap is made of an inch deep pie tin suspended under a tin covering hung in the bushy part of a tree with a small amount of kerosene in the bottom. The cover aids in that the flies hovering about once under the cover are almost sure to get into the kerosene, and in that it keeps out the rain, dirt, etc. This means, however, as a method of control is not satisfactory, as the proportion of females to males caught is about 1 to 200, and the volatile and seemingly most attractive parts of the kerosene evaporate rapidly, making it necessary to replenish it often. However, this method serves satisfactorily for check purposes.

The question often arises, whether or not a poison spray might be used. We find that Mally, in his report from the Cape of Good Hope, strongly advocates the use of a lead arsenate-sugar spray and gives tests which show favorable results. It is reported that where this

method has been used, the infestation has been reduced from *70 per cent to 5 per cent.* Why, then, cannot this method be used in Hawaii? First, let us remember that the conditions under which Mally worked were orchard conditions, and that the commercial returns of the country were vitally affected. Here there are no commercial fruit orchards

FIG. 113.—A typical Honolulu yard showing the dense maze of vegetation. Such gardens afford ideal breeding places for the fruit fly. The clean culture inspectors see that all of the ripening fruit is removed from these yards daily. (Original.)

or groves of the kind of fruit attacked by the fly, but only wild fruits and those in the home yards.

Of these wild fruits the guava is by far the most formidable host. It grows on a bush-tree (Fig. 111) ranging from two to twelve feet high. The fruit is about the size of a large apricot, brownish yellow with pink

pulp in which are many seeds. It grows anywhere and everywhere below an elevation of about 1,000 feet, in ravines, on the cliffs and by the roadside. It is in bearing at some elevation the whole year round, there being, however, maximum and minimum seasons.

In order to test the extent to which the fly attacked this fruit, nine lots of a dozen guavas each were obtained, varying in distance from

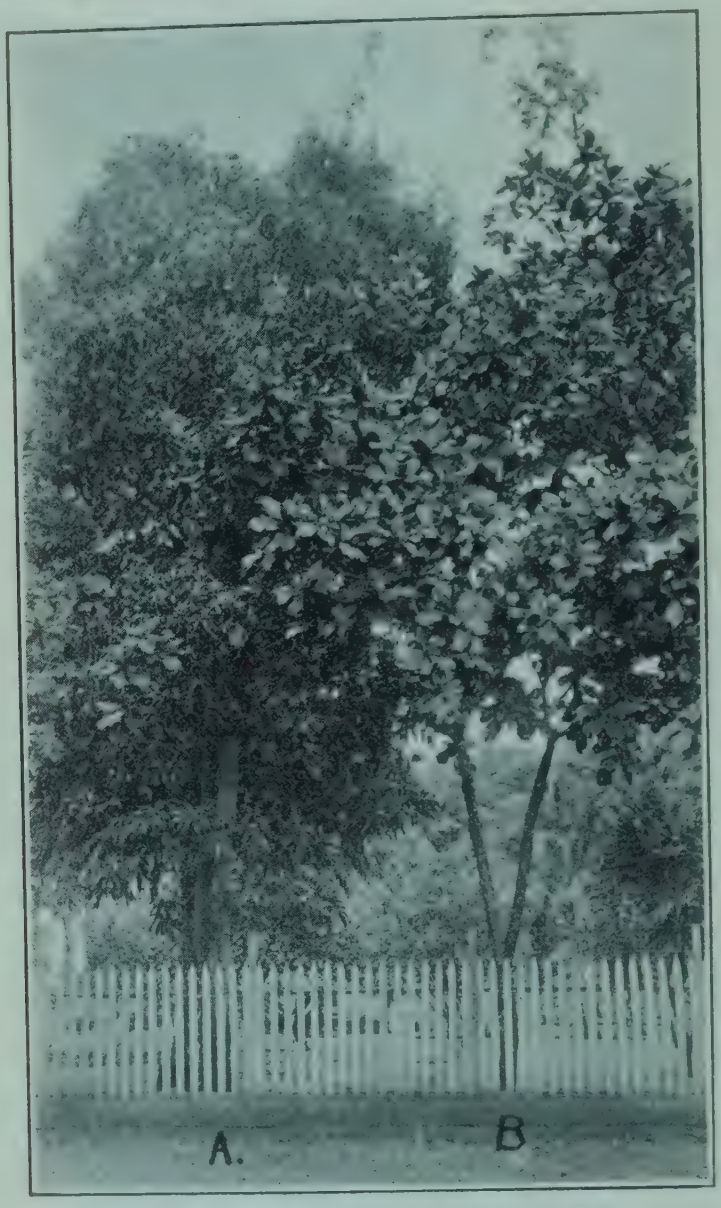

FIG. 114.—Tall host trees which present difficult problems to control work. A, mango; B, Kamani nut. (Original.)

two to five miles from Honolulu as a center, and ranging for six or eight miles the other way. These guavas were taken in the latter part of January when the fruit was not in the fullest bearing, and, with few exceptions, from the ground, in order to get those most probably attacked by the fly. From this lot of 108 fruits 125 flies were bred.

This, as against 40 for one Kamani nut two thirds as large as a guava and 25 for a single orange, led to the belief that the guava is not as extensively a breeding place for the fly as was at first supposed.

This growth, as was stated, covers acres and acres, mixed with other growth and by itself. To burn it would be almost impossible; to dig it out, a job for 10,000 men, and to spray it impracticable.

There are other reasons why spraying has not been used. One is that the height (Fig. 114) of some host trees is prohibitive without a large power outfit and this would be rendered ineffective by the maze of vegetation in the yards (Fig. 113). Even then to spray all would be impossible with the funds available, and with the wild guava adjacent as a constant breeding place, such methods would probably fail. Again, the rain falls often, and would wash away the spray or dilute it to a point of safety for the fly, making the process necessarily repeated often.

This method has been fully discussed, but until it is proven that spraying one or two trees in a yard will serve the purpose, or until some spray which is unaffected by rain is found, under the present financial status, it cannot be extensively used.

The method which is in use, however, and which has done good work is that of clean culture. Clean culture means the disposing of, so far as possible, all the progeny of the fly within a given area. Allowing 75 eggs for one female, of which one half of these should hatch females and one brood every forty days or so, it is easy to see how rapidly the numbers increase. Is not the least that can be done to pick up and destroy all fruits (Fig. 112) that have been "stung" or have the eggs or larvæ within?

This was the plan decided upon by Mr. Giffard, the present director, when he took charge of the work in November, and concurred with by the writer when he, as California's agent, entered the joint campaign in February. Mr. Giffard has been a resident of the islands almost all his life, and is acquainted with local conditions as perhaps no one else in the islands. He is an economic entomologist, having been much interested in the control of the sugar-cane leaf-hopper by parasites.

His plan was to divide the city into eight districts and each district into precincts, making each precinct about the amount one man could cover in a day. The inspected area embraces all the inhabited sections of the city running from the sea up into the valleys between the abutting ridges. Inspectors were hired whose business it is to enter each and every yard, search out each tree that might be a host for the fly, determine whether or not it is infested, and if infested, order the fruit picked and destroyed either by burning or boiling. The usual procedure is to have such fruit picked and removed to the incinerator (Fig. 115) by the regular garbage wagons. This garbage system is not the most satisfactory, yet it serves. Each householder pays a small monthly sum for the removal and disposal of his garbage. Within the close limits of the city the garbage, including all fallen fruit, is disposed of

each day, while farther out the period is two or three days. The mango, of which there are usually several trees in a yard, presents the greatest difficulties along this line. The policy has been to remove, or have removed, from the trees all fruits as soon as they begin to ripen whether infested or not, but this fruit is difficult to treat in this way

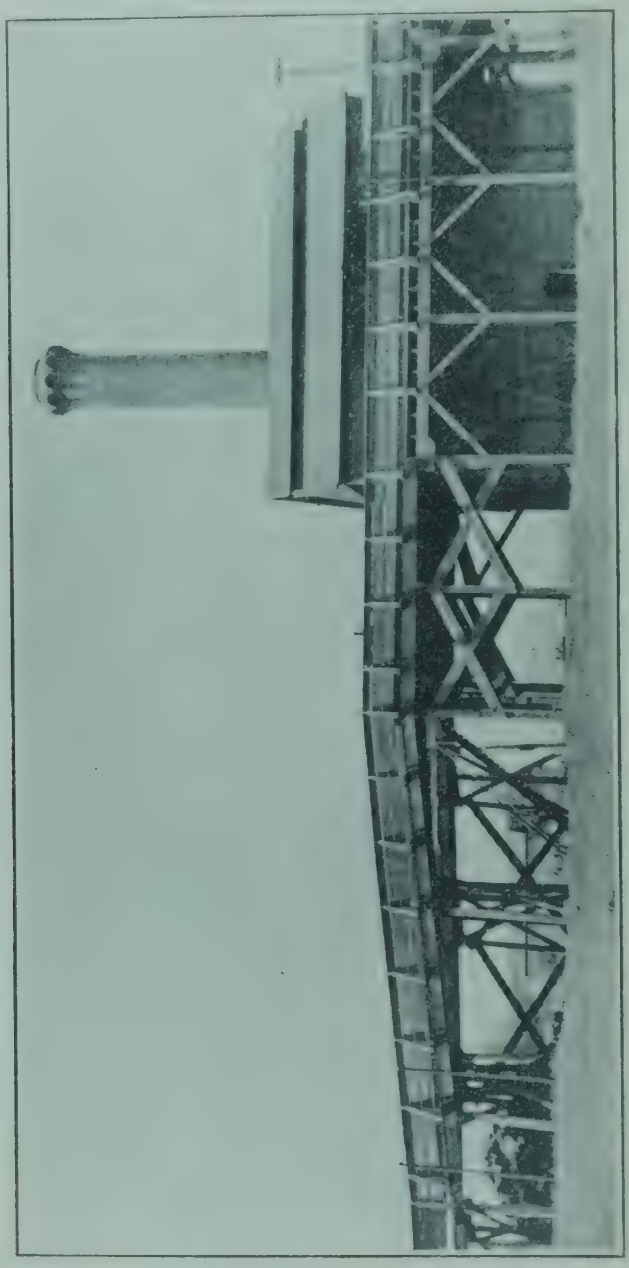

FIG. 115.—Public incinerator, where all of the fruit gathered by the clean culture inspectors is burned. The furnace is equipped with an oil burner. (Original.)

for several reasons. First, the experience has been that unless the fly is very abundant, only certain varieties of the mango are seriously attacked. There are so many varieties and crosses of this fruit that no distinction can be made although the fly prefers certain ones to others. To cut off all mangoes from the trees, which average 40 feet in height (Fig. 114), before they become ripe, robbing the poorer classes of their

chief fruit diet without reasonable cause to suppose the conditions would be materially benefited, was not thought wise, especially so, as the mango as soon as ripe falls to the ground, and should it be infested, clean culture will destroy what progeny there is quite effectively.

It has been found necessary to maintain a wagon and laborers to dispose of fruit from indigent householders and vacant lots. Efforts have been made by the authorities in charge of this work, as well as the board of health, to establish a free garbage system, using nothing but tin containers, but as yet they have not been successful.

Regulations printed in English, Hawaiian, Chinese, Japanese and Portuguese covering removal and proper destruction of infested fruit, as well as keeping the ground clean of all fallen fruit, whether infested or not, are handed by the inspectors to householders, according to their nationality.

The enlistment of the public school department has been obtained in a campaign of education among the children, involving keeping home premises clean of fallen fruit, as well as trash, and especially against throwing fruits or parts of fruits in the streets and alleys.

The absolute value of this clean culture cannot at this time be estimated. The heaviest fruit season is not yet on, but the inhabitants are finding that many of their fruits are eatable this season, where last season almost none were free from maggots. As the various varieties of fruits ripen it is noticed with satisfaction that many are so far free from infestation, others only partly infested, whereas last season very few good fruits were obtained.

The fruit stalls have undergone a great change. The owners have become tired of having their wares destroyed by inspectors and have ceased buying local oranges, etc., using almost altogether California fruits, as apples, oranges, etc. As to the native fruits they are mostly brought in from sections into which the fly has not yet been introduced. At the present time, visitors and customers may be pretty sure that the fruit sold them in the fruit stalls of Honolulu is good. An inspector visits each one every other day, in order to keep the condition as good as possible.

A few general observations, however, may be interesting, regarding other habits of the fly. The question is often asked, will the fly attack such and such fruit or not? This question cannot always be answered, yet in general, given favorable conditions and fruit with an absence of the lacteal-like fluid in the skin, as is found in the banana or papaya, and without too great acidity, the chances are favorable for its infestation. It seems unnecessary for the fruit to be edible to man but only to contain fruit pulp enough for the development of the maggot, as evidenced in the Kamani nut and coffee berry. It has been interesting to find what a number of fruits, nuts and seeds will furnish a breeding place for this pest. Since the work of clean culture control commenced, the list has continually grown longer until it presents a most formidable number of possibilities for its increase. It is obviously not

like some other pests which thrive only on one species of host plant, but if robbed of one it finds some other as well or less adapted, and the fight goes on.

With the growing fund of information concerning the pest, and this clean culture campaign and similar ones which have recently been inaugurated on the other important islands, results will surely come.

The only ultimate hope for complete control is through parasites, a subject on which certain authorities of these islands can well speak. Control of insects injurious to agriculture and horticulture by means of parasites has been a feature in Hawaii for some years, and the success obtained by territorial economic entomologists in this special line of entomological work is well known in leading scientific circles. The organized attempt to control the cane leaf hopper and cane borer, both of which pests cost the territory millions of dollars, was so successful in its financial as well as entomological results, that the territorial Board of Agriculture and Forestry has initiated a similar enterprise in connection with the Mediterranean fruit fly (*Ceratitis capitata*) and the local cotton boll worm (*Gelechia gossypiella*).

It is well known among the economic entomologists that no known effective parasites on either of these two pests has so far been discovered, and as regards the Mediterranean fruit fly, it has even been said that no direct parasite on it exists. Of course, all such matters are altogether problematical and speculative. In any case, in order to be successful, a well-organized effort must be made, and the best known and most reliable entomologists for both field work and the handling of material for breeding and colonizing should be employed. The Board of Agriculture and Forestry of Hawaii has in consequence engaged the services, for this fruit fly and cotton worm parasitic work, of Dr. F. Silvestri, a well-known expert economic entomologist. They have also arranged for the coöperation of the economic entomologists of the United States Experiment Station and those of the Hawaiian Sugar Planters' Association at Honolulu.

All these scientists are giving the subject of parasitic control much thought and will assist in the breeding and distributing of any parasites sent here by Dr. Silvestri. Preliminary arrangements are also being made to establish way entomological stations to receive and breed any parasitic material which Dr. Silvestri may see fit to send if successful in his search. That scientist is now on his way to tropical West Africa on a special expedition for the purposes above named.

These facts are particularly assuring to the members of the California State Commission of Horticulture, and should give renewed faith to horticulturists that everything possible is being done to ward off this most disastrous of pests.

CUTWORMS.

By A. J. Cook.

This year has been a "cutworm year" in northern and central California, as these cutworms, more properly caterpillars, have been very common and destructive. They are called cutworms from the habit they have of climbing up a tomato, corn, cabbage or other plant and cutting it off—eating but little and leaving the remainder to wilt and die. The one in question, *Peridroma saucia,* is called in California the "Army Worm," from its habit of marching in vast numbers from one field to another. This migration arises probably from its great numbers and does not always characterize the species. These and several

Fig. 116.—A climbing army worm fully matured. (U. S. Dept. Agrcl.)

other cutworms often climb trees and vines and do serious mischief by feeding on the foliage, and are referred to as "climbing cutworms." In the eighteen years that I have been in California, there have been four of these "cutworm years." One, 1900, was very bad. I rode in early summer on my bicycle from Oceanside to Escondido and must have killed thousands of these larvæ as I crushed them with my wheel. In 1906 they climbed the orange trees and bored into the fruit, destroying not a little. Many thought that this was due to the fact that cover crops, vetch and peas, were grown in the groves. The cover crops might have attracted the moths, furnishing a good nidus for the many

eggs, but otherwise would doubtless act to protect, as it would furnish food and thus make the climbing unnecessary.

The moth is cosmopolitan, as it is common in every part of the world, and is very destructive throughout the Pacific coast states as well as in British Columbia, though here, as everywhere, it comes in destructive numbers only occasionally.

This California army worm has not only a wide distribution, but it is a promiscuous feeder as well. Scarce any crop of field, garden or orchard is not subject to attack. In 1900 I saw it clean vegetable and truck gardens absolutely, except it drew the line at onions, though these have often been totally destroyed by the pest. It not only takes potatoes, sweet potatoes, lettuce, beets, carrots, etc., but all the orna-

FIG. 117.—Pupæ into which the army worms transform after they have burrowed into the ground. The adult moths come from these chrysalids; *a*, natural size. (U. S. Dept. Agrcl.)

mentals fall before its voracious appetite. When very numerous it usually destroys the first, second and may injure the third cutting of alfalfa. Apple, pear, peach, currant, loganberry, blackberry, raspberry, gooseberry, grape and all citrus trees are victims to this gourmand. Weeds also are to a less degree destroyed.

Life history.

The eggs of this insect are laid in regular, compact masses on the plant, often to the number of sixty or seventy. I have found them thick on the twigs of orange trees. They are hemispherical, rest on their bases and are beautifully ribbed from apex to base. They hatch in about three weeks, often less if the weather is very warm. The larva, or caterpillar, with its sixteen legs, is very varied in coloration. Indeed, Dr. C. V. Riley named this the "Variegated Cutworm." It is gray, or brownish-gray, or often greenish or pinkish; though it may

vary from light to almost black. Five conspicuous white spots along the center of the back nearer the head end are characteristic of this larva. When full grown it is one and one fourth inches long. It remains in the earth by day, or in the shade of the plant, feeding mostly by night. It pupates in the earth. At first the pupa (Fig. 117) is very light yellow, but becomes a rich mahogany-brown, near the end of its pupa stage. It remains a pupa for about three weeks, when it comes forth from its earthen cocoon as a grayish-brown moth, flecked with darker spots. A conspicuous round dot on each of the fore wings is about one and one half inches. The broods overlap each other to a considerable extent. I have reason to believe there is a late winter or early spring brood, a summer brood, and an autumn brood, which latter rarely does much damage. It is the summer caterpillars that are most to be dreaded.

Natural enemies.

In the summer of 1900 I fed one hundred of these caterpillars, collected rather late in their development as larvæ, on alfalfa, and reared only three moths, but secured a regular swarm of Tachina flies (Fig. 118). These latter had parasitized the army worm. I think the fact of these numerous flies explains the phenomenon of insect years. Their abundance nearly exterminates the cutworm, whereupon they die for want of food. Then the moths take advantage of this riddance and commence to multiply, and in three or four years are again alarmingly abundant. This makes a picnic occasion for the parasites, and they again victimize the cutworms even to their own hurt. I have also noticed Carabid beetles, both grubs and imago, especially our large Calosoma (Fig. 119) preying on these caterpillars extensively. The day of my bicycle ride, already referred to, I saw many a grub sucking the blood and life from much larger cutworms. There was always a struggle, but a vain one for the more sluggish, clumsy caterpillar.

Artificial remedies.

I have protected tomato and cabbage plants by enclosing the latter with sized paper, held by a string at top and the earth below. Bands of tin, loose cotton or tanglefoot about the trunks protect vines and trees. In the vineyards of west Michigan the tin bands are almost universally used, or were twenty years ago. A hole in the center of the band at one end and a long slit in the center of the other make it easy to tack the band, which should be two and one half inches wide, and long enough to encircle the largest tree or vine. These are required to be in place but a short time. Spraying the threatened plants with paris green, one pound to two hundred gallons of water, to which five pounds of freshly slaked lime has been added, will often save such vegetables as sweet and Irish potatoes. Spraying bunches of clover, or other succulent vegetation with this same mixture, or with two pounds of lead arsenate to fifty gallons of water, and placing this in bunches among the plants that are liable to be eaten, has often been used with marked success. It is sometimes thought that this is not successful,

for the cutworms after eating the poison, will burrow in the ground and die, though not discovered. A poison bran mash has been used with much success by many of our gardeners. A pound of paris green to forty or fifty pounds of bran, sweetened either by use of cheap sugar

FIG. 118.—The red-tailed Tachina fly (*Winthemia 4-postulata*) which is an effective parasite of cutworms and army worms; *a*, fly natural size; *b*, fly much enlarged; *c*, army worm upon which the fly has laid eggs, natural size; *d*, parasitized army worms, enlarged. (U. S. Dept. Agrcl.)

or molasses, and sufficient water added to make a stiff mash is placed in small bunches near the plants likely to be attacked.

Many birds prey upon the cutworms and chickens often feed upon them in the alfalfa fields, where they do not enter the earth by day but rest in the shade of the plants.

There are several other species of these moths belonging to the family *Noctuidæ*, so called because they are night fliers. They are attracted by lights, and are often seen in houses behind curtains and shutters. A

FIG. 119.—Eastern Calosoma beetle which preys upon army worms and cutworms. (After Lugger.)

good way to collect them is to leave the windows unscreened and open with bright lights in the room. As all are much alike in appearance and habits, the above description will suffice for most of the other species.

AN INSECT ENEMY OF PASTURE-LAND AND GROWING ALFALFA.

By E. K. Carnes and E. J. Newcomer.

At this season of the year, and particularly for the last three years, numerous specimens have been sent to the State Insectary for identification, and asking for a remedy against an insect commonly known to the growers under the popular names of "giant mosquito," "daddy long-legs," "mosquito-catcher," "gallinipper," etc. Also many growers have brought in numbers of dirt-colored, cylindrical larvæ found feeding on the roots of various forage-crop plants, and which they called "leather-jackets," or "meadow maggots."

Usually the complaint was from pasture land in the northern counties, where it was reported that several hundred acres had been destroyed. Cases are on file dating as far back as 1897, where this pest has taken plantings of barley, oats, and clover; also during the succeeding years, complaints from various sections of the state have been received of the destruction wrought by this pest. In fact, authentic records show that as far back as 1874, fields and pastures were destroyed by the same or a similar insect. During the present spring several complaints have been registered where young alfalfa was damaged to an extent that caused considerable anxiety to the growers in the Sacramento River section, and immediate steps were taken to procure specimens, and a systematic plan of study inaugurated leading toward some solution of the problem.

The so-called "meadow maggots," or "leather-jackets," are nothing more than the young or larvæ of the awkward "mosquito catcher," which has been identified as *Tipula simplex* Doane. This is one of the crane-flies, the larvæ of which have widely varying habits, some living entirely in water, while others live in moist earth and burrow through it like earthworms. The adult flies of this particular species are unable to cause any damage at all, but the larvæ, or maggots, which live just beneath the surface of the soil, burrow through it freely, and feed on the juices of the roots of clover, grasses, and other plants.

DESCRIPTION.

Egg (Fig. 120 A).

The egg is cylindrical, rounded at the ends, nearly twice as long as wide, and has an even, very finely granulated surface. When dry it is dull dark gray in color, but when moistened it becomes shiny black. It is very small, being about one thirtieth of an inch in length. The exact measurements in millimeters are, length, 0.85; width, 0.45.

Larva (Fig. 120 B).

The full-grown larva is cylindrical, elongated, slightly flattened dorso-ventrally, tapering somewhat at either end, but mostly toward the head. The head is small and black. The body is dirty brownish, dark-

est above and with the segments marked slightly with darker rings. The body terminates in six spiny processes, between which are two black spots. These are really openings—the spiracles through which the larva breathes. Average length, three fourths of an inch (18 mm.); width, 3.1 mm.

Pupa (Fig. 120 C).

The pupa has much the same shape as the larva. The developing eyes, wings, and legs can be seen beneath their protective coverings. There is a short spine on the head between the eyes, and a number of spines on the thorax. Two slightly clubbed and distinctly annulated

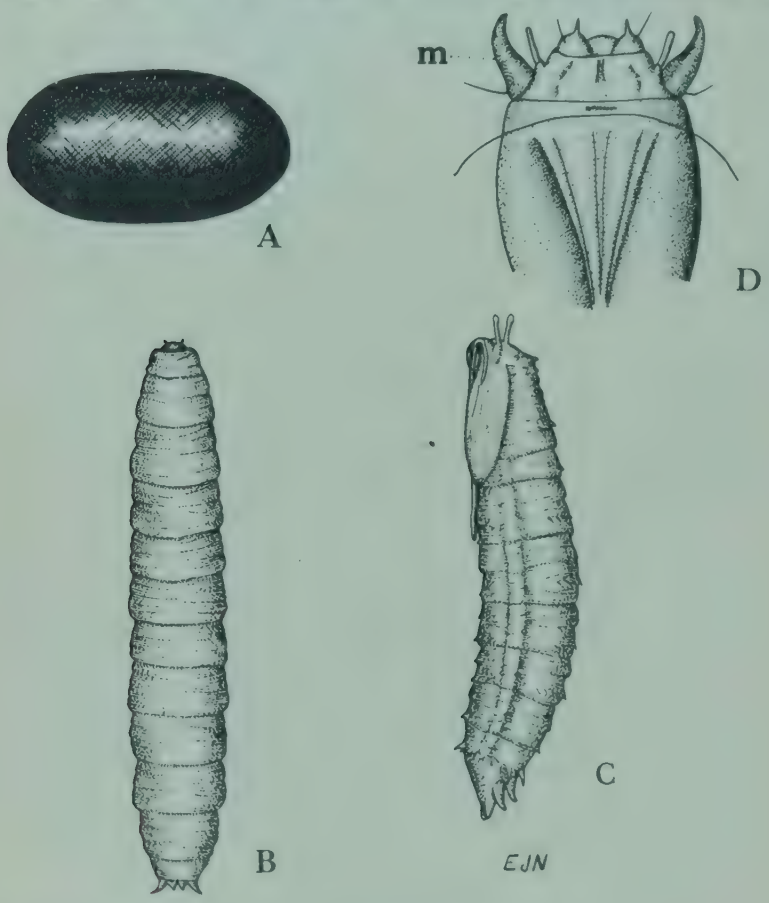

FIG. 120.—*Tipula simplex.*
A—Egg, magnified 36 times. B—Larva from above, magnified 3 times. C—Pupa, side view, magnified 3 times. D—Head of larva, showing extended mandibles (m), magnified 16 times. (Drawing by E. J. Newcomer.)

respiratory tubes project forward from the anterior part of the thorax. The abdomen consists of six segments, each segment except the last provided ventrally with a submarginal transverse row of eight or ten spines, dorsally with a similar row of ten or twelve spines, and on the lateral ridge with two larger spines. The last segment has a number of stronger spines forming a ring about it. All these spines point backwards and are used in helping the pupa to wriggle out of the soil. Length, about two thirds of an inch (15 mm.).

Adult (Fig. 121).

The *male* is a slender, long-winged, long-legged, yellowish-brown insect. It has a rather wide, dark brown stripe down the middle of the thorax and abdomen, and a narrower one on each side of the abdomen. The wings have four dark brown spots near the anterior margin, and a small brown spot on the margin, at the end of each vein. There is also a dark broken line running lengthwise down the center of each wing. The legs are uniformly brown.

The *female* is quite different from the male. It is darker in color, has a stouter, more pointed abdomen, shorter, thicker, and more hairy legs, and is practically without wings. A close examination will show a little hairy pad where each wing should be. This is the rudimentary

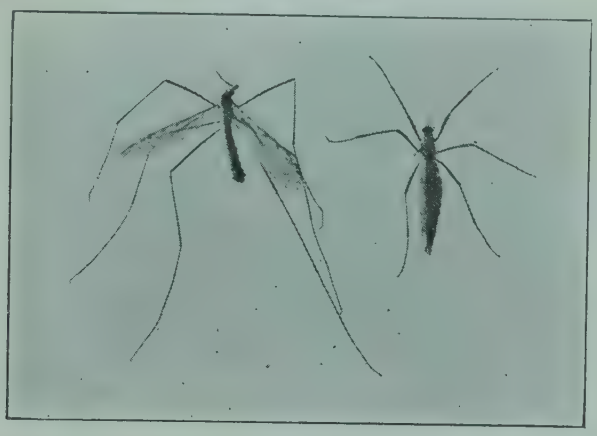

FIG. 121.—*Tipula simplex* Doane; male and female.

wing. The length of the body of the female is about 13 mm. (a little over half an inch). The male has a body length of scarcely 10 mm., and the wings are 11 mm. long.

HABITS.

As we have already said, the larvæ of this species of crane-fly burrow through the soil just beneath the surface, feeding on the juices of various roots. They are known to attack the roots of grasses, clover and alfalfa. They do the most damage to pasture lands where they are undisturbed by plowing. We are told that only the young alfalfa suffers from their attacks, the roots of the older plants being tough enough to resist them. The larvæ appear in January or February, after the grass has started well, and grow rapidly, pupating in March. The pupæ are found in the same positions as the larvæ, a few inches below the surface. They are quiet and are unable to take any food.

It is probable that the pupal stage does not last more than ten days or two weeks. When the adult is ready to emerge, the pupa, with the help of the backward-pointing spines on its abdomen, worms its way to the surface of the ground. Then the skin splits along the back of the head and thorax, and the adult fly wriggles out and crawls up some plant stem, where it hangs until its wings and body are dry. When

the insect first emerges, it is very soft and almost transparent. As it dries it assumes the brown colors described above, the wings stiffen, and the body becomes hardened. There seems to be no particular time of day when the insects emerge, though the most of them probably come out during the morning. However, we have seen them emerge at all times of the day, and have found flies in our breeding jars in the morning which had emerged during the night.

The males, as soon as they can fly, go in search of the wingless, spider-like females, and mating often takes place before the female is dry. One of the males that emerged from a breeding jar on the afternoon of March 15th, mated with a female at 2:30, twenty minutes after she had emerged. They remained in position until 3:45, or an hour and a quarter. The next morning, March 16th, the female began laying eggs shortly before eleven o'clock.

The egg-laying process is very interesting. The female crawls excitedly over the surface of the ground searching for a natural crevice or a soft place. In our breeding jars the soil was soft and finely pulverized, and the females had no trouble in depositing their eggs, but in pastures they experience considerable difficulty in finding suitable places, and probably as often as not lay eggs in some natural crevice in the soil. In the breeding jars, as soon as a female found a place to her liking, she stood up on tiptoe, curved the abdomen forward until it was at approximately right angles with the surface, and inserted its sharp tip. Then she began bobbing up and down, and by this means a hole was gradually formed in the soil. The tip of the abdomen is formed of four, pointed, longitudinal plates, like four fingers held closely together. These can be alternately spread apart and brought together again, and this action aids in forming the hole. Fig 122 shows the position assumed by the female in ovipositing. When the abdomen is forced nearly its length into the soil, as is shown in the figure, the insect remains quiet and usually deposits several eggs before moving to another place. We noticed one female that remained at the same place for two hours and a half, and when she left, nine eggs were found to have been laid.

The number of eggs produced by a single female varies considerably. We placed a freshly mated female in a small bottle with half an inch of dirt in it. Twenty-four hours later she had stopped laying eggs, and the earth was removed and examined. Eighty eggs were found, but their small size and neutral color make them difficult to see and there were doubtless more in the soil. The body of the female was examined, but there were no eggs left in it.

The eggs from five freshly emerged females were dissected out and counted. The numbers ranged from 97 to 164, and averaged 130. It is remarkable how much of the body cavity is filled. Not only is the abdomen packed with them, leaving very little room for the other organs, but a number of eggs were usually found in the thorax among the leg muscles. This is interesting, for in species where the females

are winged, the thorax would be completely filled with the huge muscles that move the wings and legs. In this species, the wings of the female are of no use whatever, and the space usually occupied by wing muscles is given over to eggs. In spite of this, the total number of eggs is rather small. Several other allied species are known to produce from 300 to 600 eggs, according to Jas. A. Hyslop, of the U. S. Bureau of Entomology.[1]

It is evident that there is but one brood of this species a year. We took eggs laid March 15th, and kept them moist in a covered dish. At about the same date we allowed fertilized females to oviposit in a pan of soil in which were a number of young alfalfa plants. At this writing (May 15th) none of the eggs kept in the dish has hatched and we are unable to find any larvæ in the soil, though we find a number of unhatched eggs. Some of these eggs have shrivelled up, but most of them are still plump and to all appearances alive. The pasture land will be largely dry before long, so it seems conclusive that these eggs remain as they are until winter, only hatching when there has been sufficient rain to thoroughly wet the soil and start a growth of grass, probably in December or January.

NATURAL ENEMIES.

When the larvæ have become particularly numerous in a given locality, a Tachinid fly usually appears, and sometimes considerable numbers of the larvæ are parasitized by it.

In the paper by Mr. Hyslop cited above, a list is given of about a hundred birds which have been found to feed upon the eggs and adults of various crane-flies in the United States. About forty of these birds are found in California, and we may suppose that their habits are the same here as elsewhere. Among these may be mentioned the Wilson snipe, killdeer, flicker, several flycatchers, the common blackbird, the meadowlark, the oriole, and a number of sparrows and swallows. Although both the parasite and the birds undoubtedly help to check the pest, they can hardly be counted upon to do any great amount of good.

CONTROL.

We can, at the present time, only suggest a few possible remedies. The only control measure that would appear to be of any practical use consists of some method which would destroy the larvæ and pupæ, and thus prevent a recurrence of the pest the following year. The larvæ are not able to travel any distance, and the wingless condition of the females makes it impossible for them to get very far from their pupal shell. If the larvæ could be practically wiped out in a given field, that field would undoubtedly be free of them for several years.

A thorough plowing, where it is practicable, would destroy the larvæ, as it would leave them nothing to feed upon. This should be done in early February, or as soon as the larvæ are noticed. It must be thor-

[1]The Smoky Crane-Fly. Bul. 85, pt. 7, Bur. Ento. U. S. Dept. Agriculture, 1910, p. 127.

ough to be effective, and must be done before the larvæ pupate, as all the pupæ that escaped mechanical injury, or were not exposed, would produce adult flies. A sprinkling of salt or lime over the land at the proper time might do a great deal toward destroying the larvæ. The farmer at once sees objections to these methods, because they involve a destruction of his crops or his pasture. But when these worms are very numerous they practically destroy the vegetation anyway, and it is better to destroy both pest and crop once, than to have the pest go on ravaging the crop year after year. These measures are merely suggested as being worth experimenting with.

It seems reasonable, too, that something could be accomplished by a rotation of crops, but trials would have to be made before anything

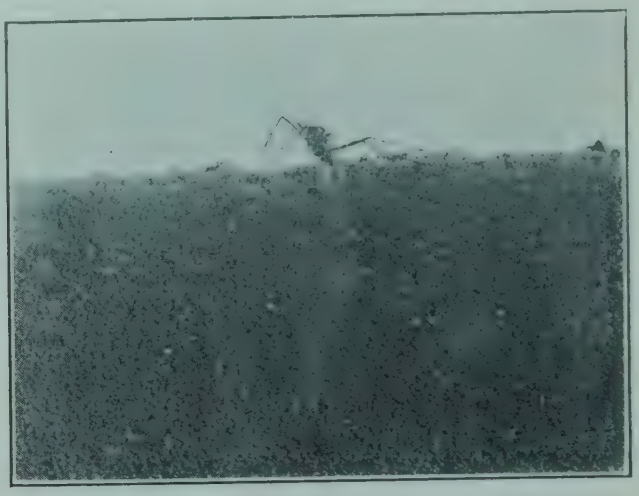

FIG. 122.—*Tipula simplex;* female ovipositing.

could be recommended. As a mere suggestion, and to indicate what might be done, potatoes might be grown in place of alfalfa for a year. It is not known that the worms will attack potatoes, though it has not been proved that they will not do so, if there is nothing else for them to feed upon. Experiments would settle the matter.

EMERGENCY CONTROL.

In cases where this pest has just made its appearance, and where quick eradication is desired, or even in cases where the infestation is quite serious, and the nature of the territory attacked is such that a slight expenditure would be justified to stay the spread of the pest, the following simple remedy may be applied with excellent results: One pound of cyanide of potassium dissolved in fifty gallons of water. Sprinkle the solution thoroughly on the surface of the infested area. This remedy has been used in California, and as high as 28 dead larvæ to the square inch have been counted after its use. As cyanide of potassium is a very violent poison, care must be used in handling the same, and stock must not be run on the land for several weeks.

MAY CROP REPORT.

By G. E. Merrill.

The general prospects for a large crop of deciduous fruits are not quite so pronounced at this date as our April reports indicated. This condition does not surprise us, as we pointed out in our previous discussion, the effect would be more apparent as the dry season progressed.

A summary of the crop conditions of the principal deciduous fruits, deduced from the reports of the county horticultural commissioners, follows:

Almonds. This year's crop of almonds will doubtless be larger than that of last year. This condition is due not so much, perhaps, to a heavier set as to the increased size of the younger bearing trees and new acreage coming into bearing.

Apples. Commissioner Volck of Santa Cruz county reports that present signs indicate a crop of apples in Santa Cruz county about equal to that of last year, when 3,000 cars were shipped out. Within the next few months, there is, of course, a chance that factors may develop that would cause us to modify this estimate. In Sonoma county, Commissioner Gallaway estimates this crop at 110 per cent of last year. This estimate may have to be modified later. In the other counties of the State, the apple crop promises to be equal to last year's or to exceed it.

Apricots. At this date the reports from Alameda, Santa Clara and Orange counties have not been received. Without reports from these counties, which are among the heaviest apricot producing counties in the State, it is impossible to make a general estimate. Ventura, Contra Costa, Solano and Los Angeles counties, all important apricot growing districts, report that this year's crop will equal or exceed that of last year.

Cherries. Reports so far received led us to believe that this year's crop will be larger than last year's. In some sections record breaking crops are reported. The packing and shipping of the earlier cherries is now well under way.

Peaches. The outlook for a plentiful supply of peaches still continues good. Reports have been received of a large loss from Peach Curl Leaf where no attempt was made to control this disease. The dry weather of last fall and winter is also having its effect.

Pears. The pear crop promises to be about the same as last year's, although the fruit is dropping very badly at present. Commissioner Bloomer estimates Sacramento county's crop at 95 per cent of last year's. Both Sonoma and Mendocino counties report better crops than last year.

Prunes. Without a report from Santa Clara county, it is not possible to state what the present outlook is. Although we have not heard from

Commissioner Morris, reports from other sources lead us to believe that crops in this section will not be as good as last year. Reports indicate that there are still many prunes on the trees, but that the foliage is not abundant or in a good condition, especially in the unirrigated orchards which make up by far the larger part of the Santa Clara valley orchards. In the counties heard from the estimates vary from 75 to 150 per cent of last year's crop, with a general average of perhaps 100 per cent.

*PLANT LICE AFFECTING CITRUS TREES.

By E. O. Essig.

PART II.

Natural Enemies of the Citrus Plant Lice.

CHRYSOPIDÆ.

CALIFORNIA GREEN LACE WING OR APHIS LION.

(Chrysopa californica Coq.)

One of the most common insect predators, working on all sorts of soft-bodied species, is the common green lace wing, called Aphis Lion because of its destructiveness to all plant lice (aphids). The eggs, larvæ, pupæ and adults are to be found everywhere in the fields, woods and orchards; wherever there are infestations of plant lice one is almost sure to find the larvæ of the *Chrysopa*. In the citrus orchards of southern California they are very abundant and play an important part in the control of many bad pests, but more important in keeping down the aphids which have already been described. When there is no prey in the orchards they go to the fields and brush to seek other game and return as soon as the lice begin to appear. The part played by this insect in an economic way certainly justifies a short description here in connection with the predaceous Coccinellids and Syrphid Flies.

Eggs—(Fig. 123 B). The eggs are very small, pearly white in color, oblong in shape with the base drawn out to connect with a fine hair or pedestal which supports it nearly half an inch above the surface to which the hair is attached. The egg itself is not more than one eighth of an inch in length. The adult insect has no doubt employed the method of placing her eggs on long stalks for the purpose of putting them out of the reach of other crawling insects which would otherwise devour them. They are deposited singly or sometimes in small groups on the upper sides of the leaves, or in fact on most any part of a tree, plant, or any other support.

Larva—(Fig. 123 A). When first hatched the larva is, of course, very small, but grows rapidly. The first born vary from a light yellow to a gray color. As soon as it leaves the egg the search for food is begun and apparently there are few insects which escape its appetite. At first only the very youngest plant lice are devoured, but it is not long before insects twice and three times as large as the chrysopid larva

*Part I of this article was published in Vol. I, No. 4, pp. 115-133 of "The Monthly Bulletin" and includes the descriptions of the plant lice or aphids.

are destroyed. The full-grown larva varies from half to nearly a full inch in length, is bright yellow with dark red markings distributed as shown in the drawing. The head is equipped with a large pair of mandibles, grooved on the inner side, curved like a sickle and pointed. With these it penetrates the body wall and sucks out the contents through the grooves. The legs are short with sharp claws to clasp firmly the footing which it may have in order that it might, as is the habit, lift the prey bodily into the air where its struggles are in vain, and hold it there until all of the body juices have been extracted. This operation can easily be observed in the field. So fierce are they that they devour not only mealy bugs, the larvæ of Coccinellids, but their own kind. I have placed from four to eight in a small box or bottle and after a few days would find only two, or more often, only one left. In order to make sure this point the operation has also been observed repeatedly, but cannibalism is not uncommon among predaceous insects. Though the good from

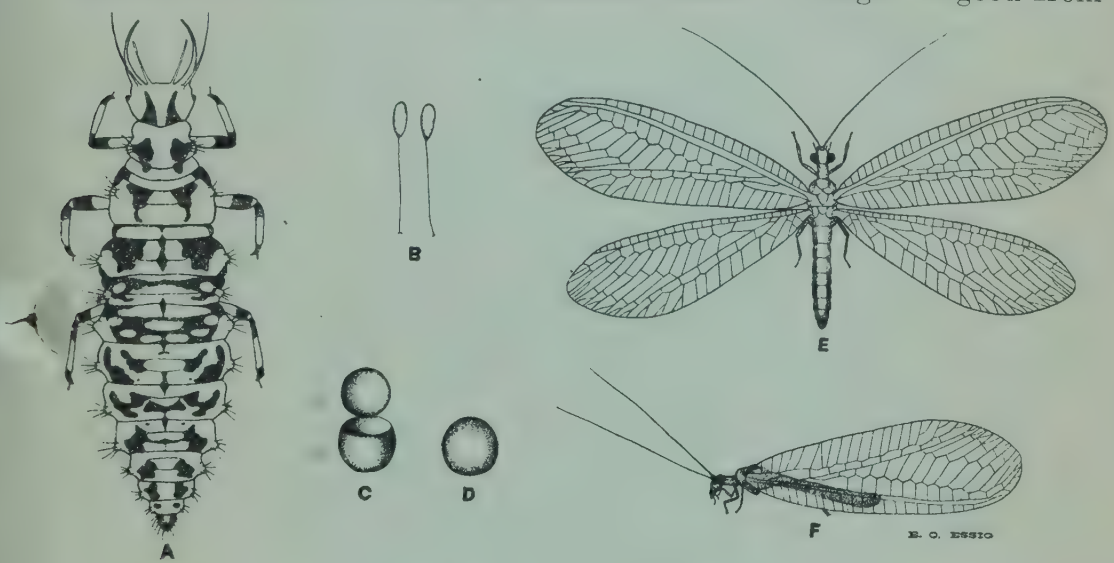

FIG. 123.—*Chrysopa californica.*
A, larva; B, eggs; C, pupa case open; D, pupa case intact; E, adult with wings spread; F, adult with wings folded.

this insect is often great, I have often thought that the harm done, by eating other beneficial insects, more than overbalanced the good done. For instance we imported the Coccinellid enemy (*Cryptolaemus montrouzieri*) of the citrus mealy bug into our orchards at Santa Paula and it was impossible to go into the field without finding nearly every chrysopid larva eating the young of this ladybird beetle. In not a few instances entire colonies were entirely destroyed, and though many of the mealy bugs also fell a prey to the chrysopids, they seemed to prefer the larvæ of the ladybird. But other than this I have seen very little to count against it, and as an aphid feeder alone the good is very marked.

Pupa—(Fig. 123 C and D). When fully developed and ready to undergo transformations the larva spins a thin, hard-walled, globular, pupa case about itself (Fig. 123 C shows mouth open after escape of the adult, D shows the cocoon) in some crack or crevice and remains dormant for some time. These globular pupa cases are often nearly

covered with long white filaments—not unlike cotton—by which they are fastened, and are grouped together in small lots or may be single. It is this stage that is subject to severe attacks of internal parasites, which play havoc with rapid development of numbers. The parasite, *Isodromus iceryæ* How., is common here and has been reared in large numbers from the pupa cases of the green lace wing and also from the pupæ of the brown lace wing (*Sympherobius augustus* Banks).

Adult—(Fig. 123 E and F). The adult insect is from five sixteenths to three eighths of an inch long and twice as long including the length to the tip of the folded wings, of a beautiful green color with a longitudinal, dorsal, yellow band extending from the front of the head to the penultimate abdominal segment. There are four large, membranous wings, wonderfully nerved (from which comes the name lace wing), and bright, transparent green. The head is yellow above, green beneath, and amber or brown on the sides. The thorax and abdomen are green excepting the dorsal yellow band. The legs are green with tips of the tibiæ and the tarsi amber. Eyes large, iridescent green. Antennæ long and setaceous, light yellow or transparent white with amber tips. The wing veins and the entire body are clothed with fine hairs.

COCCINELLIDÆ.

Feeding upon plant lice are always to be found the young or larvæ of the Ladybird Beetles (*Coccinellidæ*). There are three common aphid feeders which are to be found in nearly every orange orchard and which should receive special attention here. They are the common

FIG. 124.—A, *Coccinella abdominalis;* B, *Hippodamia convergens;* C, *Coccinella californica;* D, *Scymnus sordidus.*

Red Ladybird Beetle *Coccinella californica* Mann, the Red Spotted Beetle *Hippodamia convergens* Guer., and the Ashy Gray Ladybird Beetle *Coccinella abdominalis* Say. Besides these there are a few specimens of the genus *Scymnus* to be found, the most common and efficient being a small brown native species, *Scymnus sordidus* Horn.

The eggs of these ladybird beetles are laid in clusters not unlike bunches of cigars on end, and may be found almost anywhere, from board fences to the various parts of the foliage of a tree. They are small, pointed at both ends, and salmon colored. The accompanying pictures give a fair representation of different clusters. The eggs of *S. sordidus* are deposited singly and are very difficult to find.

The larvæ as they emerge from the upper ends of the eggs soon begin their search for food, which consists of very small insects at first. They grow very fast and develop tremendous appetites. The body is long, very rough, hairy and dark with red or yellow markings on the dorsum. They have six legs and are capable of traveling very rapidly. As soon as fully matured they hang themselves up by the tail-end to some twig, leaf, limb, or any other convenient place of support and transform into the pupal stage. These pupæ may be seen in considerable numbers almost anywhere in the orchards. They are of a reddish brown or gray color with dark markings. When touched or disturbed they will suddenly throw up the head as if to strike the assailant. From this stage emerges the adult beetle, which produces more eggs and begins another life cycle. All of these stages may be found throughout the entire summer and fall months, while the adult forms are found at any season of the year in southern California.

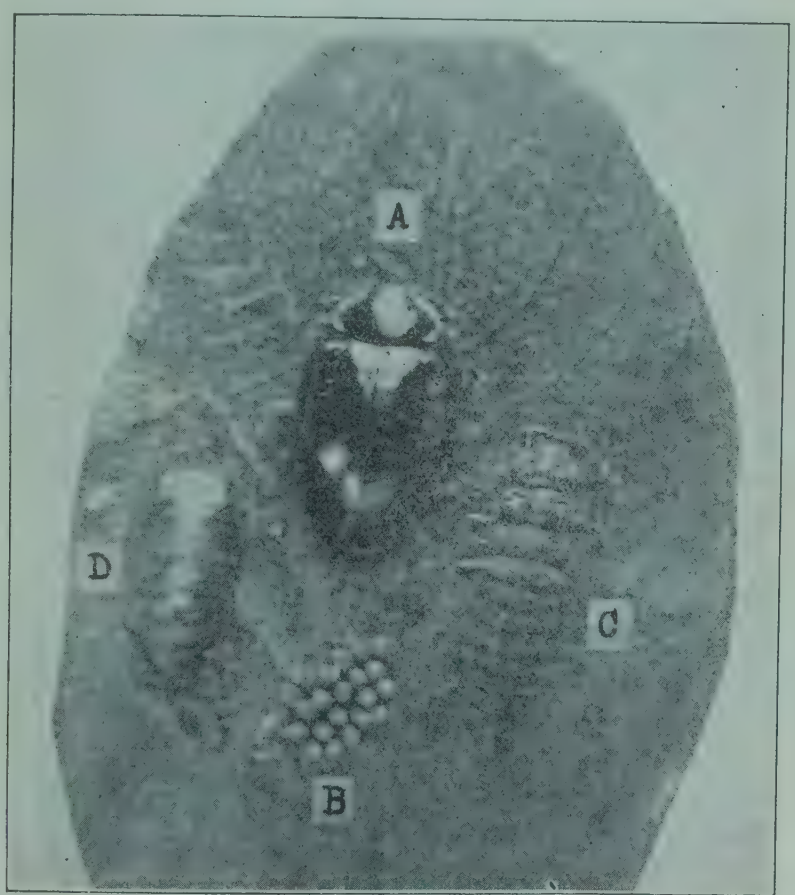

FIG. 125.—*Coccinella californica.* A, adult; B, eggs; C, larva; D, pupa.

Coccinella californica Mann. (Red Ladybird Beetle; Figs. 124 C and 125.)

A scarlet-red beetle very common throughout this State. Head black; thorax black with white or pale spot on each margin; elytra orange or scarlet-red with no other marking than a small rhomboidal dark spot at the middle base, known as the scutellar spot. Length 5.0 mm. to 6.0 mm., width 4.0 mm. to 4.7 mm. Feeds on many different species of aphids.

Hippodamia convergens Guer. (Black Spotted Red Ladybird; Figs. 124 B and 126.)

Red beetle with twelve black spots on the dorsum. Head black; thorax black with two narrow white lateral margins and a very small median white spot at the base; elytra varying from light to very dark red, each with six black spots, the posterior three invariably isolated among themselves and usually constant, the anterior spots usually smallest and variable; scutellar spot black, small; legs black throughout. Average length 5.2 mm., average width 3.2 mm.

The larvæ when fully developed vary from one quarter to nearly three quarters of an inch in length. They are dull black with bright orange or yellow markings on the back.

FIG. 126.—*Hippodamia convergens.* A, adult; B, eggs; C, larva; D, pupa.

The pupæ are amber or reddish-brown with transverse dark bands across the body and numerous dark spots on the dorsum.

This is the most common form we have in the southern part of the State and is a very important and helpful insect. It is being sent in great numbers by the State Commission to the melon fields of Imperial County to prey upon the melon aphis there, as is also *Coccinella californica.*

Coccinella abdominalis Say. (Ashy Gray Ladybird: Figs. 124 A and 127.)

Gets its common name from its gray color. The following is a description after Thos. Casey:

"Broadly oval and strongly convex, very finely and obsoletely punctulate (the side margins as in Cycloneda); upper surface pale brownish-yellow, the head pale and immaculate; pronotum with a basal black spot at two fifths from the middle and a short transverse spot before the scutellum, also with two posteriorly converging black spots at the center and a narrow elongate spot on the median line joining the antescutellar spot, and, at lateral eight and basal third, a small rounded spot; scutellum black in the male; elytra each with a sub-basal trans-

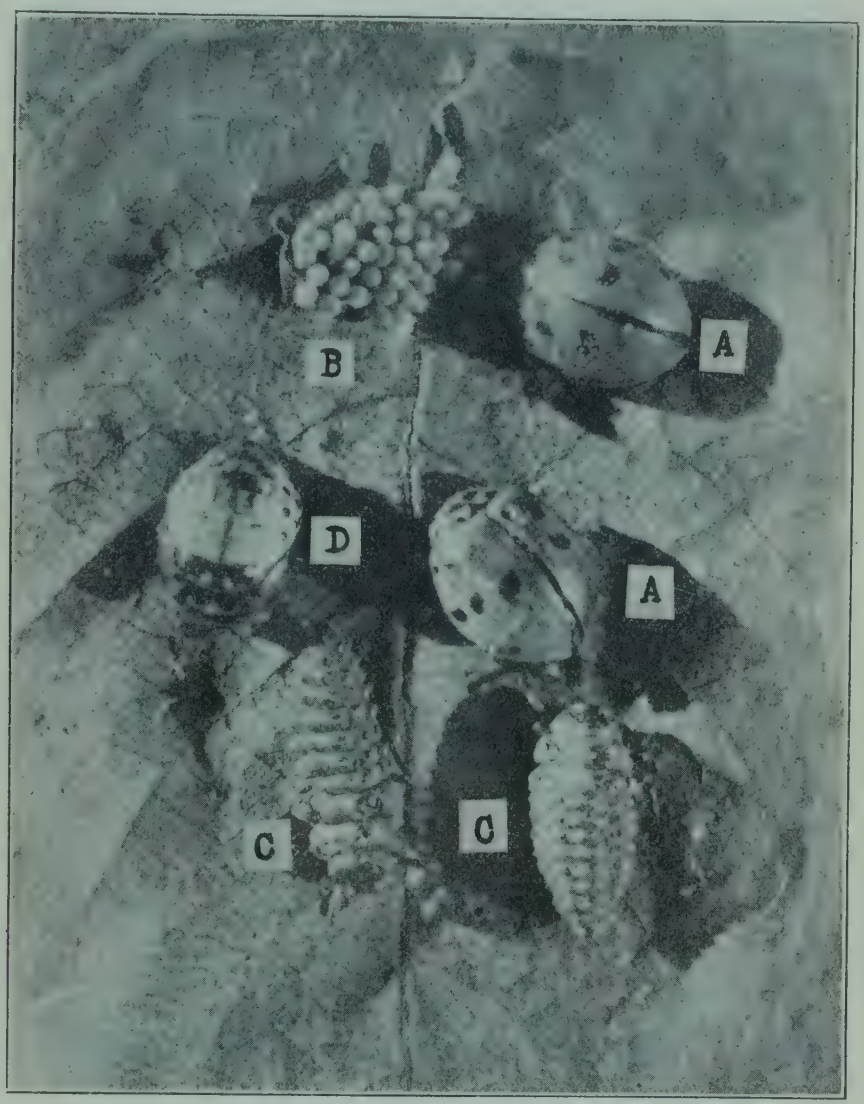

FIG. 127.—*Coccinella abdominalis.* A, adults; B, eggs; C, larvæ; D, pupa.

verse series of four small black spots, a median series of three spots, the inner the largest and transversely crescentiform and, at apical fourth near margin, another small rounded black spot; under surface and legs pale. Length 4.25 to 5.25 mm., width 3.4 to 4.0 mm." Jr. N. Y. Ent. Soc. Vol. VII, p. 93, 1899.

In all there are seven black spots on the thorax and eight on each elytra or wing cover.

The larvæ resemble those of *Hippodamia convergens*, but are a little larger and have very light or yellow spots on the dorsum instead of orange spots.

This insect works on various plant lice of the orange, but is the most effectual check we have in this county on the Walnut Louse, *Chromaphis juglandicola* (Koch.), which it seems to prefer to all other aphids. There are millions of the eggs, larvæ, pupæ and adults to be found in every walnut orchard in Ventura County and large numbers occur in the citrus orchards in the early spring before the walnuts begin to leaf out. It is by far the most important beneficial insect of the three herein described.

Scymnus sordidus Horn. (Figs. 124 D and 128.)

This is one of the smallest of the aphid feeders, but very common in localities near the foothills, where it feeds especially upon *Aphis gossypii* Glover.

The larva is considerably larger than the adult, being nearly a quarter of an inch long and half as wide. It is easily recognized by its heavy coating of rather long, white, cottony wax and is often mistaken by citrus growers for a mealy bug.

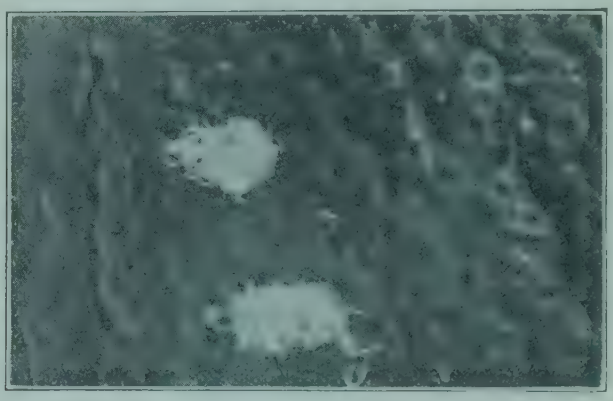

FIG. 128.—Larvæ of *Scymnus sordidus*.

The adult is scarcely more than one eighth of an inch long and two thirds as wide; light brown to very dark brown in color, and with elongated body. It is technically described by Thos. Casey (see P. C. Jr. Ent. Vol. III, No. 3, p. 520, Sept., 1911) briefly as follows: "Body elongate oval. Length 1.65 mm., width 0.9 mm. Pronotum piceous, minutely, not very closely, punctulate, the sides not quite continuous. Elytra pale, with margins nubilously blackish, more broadly at base, finely and rather closely punctuate. Abdominal lines extending outward externally parallel to the edge of the segment and a slight distance therefrom, presternum relatively slightly wider between coxæ, flat and wholly devoid of carniæ; genital or 'sixth' ventral segment, usually developed."

This insect is a native of California and especially abundant in the southern citrus counties, where it also does good work on the citrus mealy bug.

SYRPHIDÆ.

Always among the plant lice are to be found greenish, flat, sticky-looking "worms" which are decidedly pointed at one end and which do not have distinct head, eyes or legs. These so-called "worms" are the larvæ or maggots of a two-winged insect or fly of the order Diptera and the family *Syrphidæ*, which are commonly called Syrphid or Flower-Flies. The larvæ (Fig. 129 A) vary from the minutest first-hatched maggot to nearly an inch in length, according to the species to which it belongs. They are usually light or dark green, but some may be brown, orange, very light or nearly black. Those feeding upon the citrus plant lice and herein described are green with a longitudinal darker green or brownish stripe on the dorsum. The mouth is situated at the small end and all of the food is obtained by puncturing the body walls of the lice and then sucking out the contents. This operation is easily observed in the field. The maggot firmly supported by the large posterior end, raises itself up and begins to blindly move its mouth-end about in quest of food. If it touches a plant louse it immediately raises it into the air and sucks it dry. This is very rapidly repeated, with very disastrous results to the lice. When the larva is full grown it seeks some sheltered spot in which to pupate (transform into the adult fly). This it may do on the stems or upon the surface of a leaf. The pupa stage is shown in Fig. 129 B and is a long, roundish or oval, brown body, which shows no signs of life. From this emerges the adult fly, which removes one end of the pupa case to escape. The adults under consideration are dark with transverse yellow bands across the abdomen as shown in the accompanying cuts. They are very swift fliers and are often mistaken for bees. They are common around flowers, feeding upon the nectar and from this habit get the names "Flower or Honey Flies." On hot days they are sometimes very numerous and are called "Sweat Flies" in the eastern states. Their eggs are deposited singly upon leaves and twigs which are infested with plant lice and these give rise to the green larvæ.

While these insects do much to prevent the spread of the plant lice, they are in turn preyed upon by other insects. Ants, which foster and protect the plant lice, kill and carry off the larvæ in large numbers and greatly reduce their efficiency. Internal parasites also prey upon them. I have hatched a large one from the pupæ of *Syrphus americanus* Wied. Insect Life, Vol. III, p. 153, reports the internal parasite *Hemiteles syrphicola* Ashm. as being reared from *Allograpta obliqua* Say.

There are three species here which are doing good work in keeping down the citrus plant lice: a very large species, *Lasiophthicus pyrastri* Linn., the common Syrphid, *Syrphus americanus* Wied., and the small species *Allograpta obliqua* Say. The following brief descriptions of the adult forms have been prepared:

*Lasiophthicus pyrastri Linn. (Fig. 129.)

This is the largest of the three species named above and measures seven sixteenths of an inch in length. The large compound eyes occupy most of the head and are dark Indian red or brown. The face is yellow and hairy, with median dark line. Antennæ are black with long dorsal arista. Thorax iridescent dark blue or green, covered with long fine hairs or pubescence. Scutellum same color as the mesothorax. Legs—coxæ dark; femora dark with tips light; tibiæ amber or yellowish, slightly darker at tips; tarsi dusky. Abdomen velvety black with three pairs of marginal curved transverse, broken bands on the

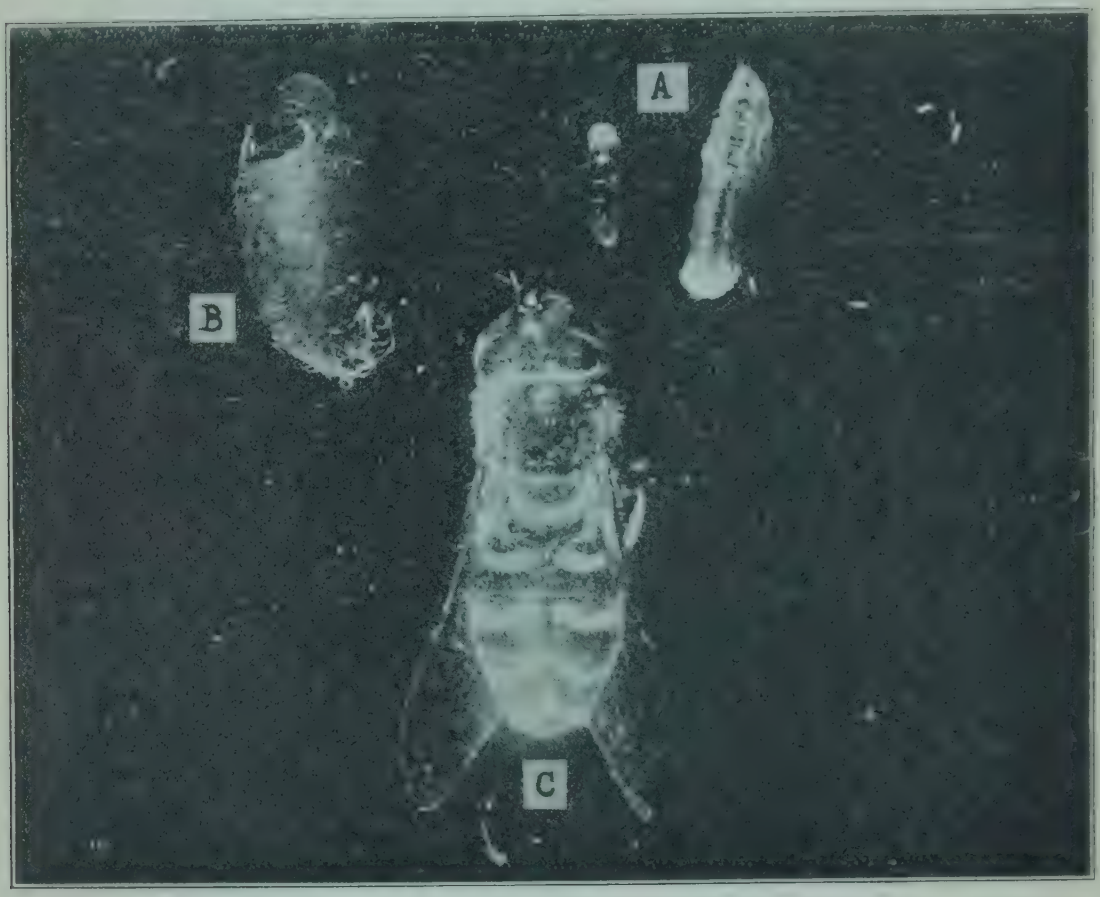

FIG. 129.—*Lasiophthicus pyrastri.* A, larva; B, puparium; C, adult.

dorsum. These bands do not come together in the middle and really form six yellow stripes.

This is a very widely distributed and common species and feeds on nearly every species of plant lice. It is especially abundant on twigs infested with *Macrosiphum citrifolii* Ashm., *Toxoptera aurantia* Koch., and *Aphis gossypii* Glover.

*NOTE.—I am indebted to Prof. C. F. Baker, of Pomona College, for the identification of the species of these Syrphids.

Syrphus americanus Wied. (Fig. 130 A.)

Although this species is much smaller than the one above described, it is considered to be one of the largest species in the genus, averaging three eighths of an inch in length. It greatly resembles *Lasiophthicus pyrastri* L. in general form and color. The eyes are dark reddish brown. Face amber yellow with dark band in the middle extending from base of the antennæ to the mouth. Antennæ black, with dorsal arista. Thorax iridescent green, covered with fine long hair. Legs—Coxæ dark; bases of femora dark; remainder of legs amber brown. Abdomen rich shiny black with three pairs of transverse yellow, broken bands along the dorsal margins. These bands do not unite in the middle by one half their lengths. There are also two very narrow transverse yellow bands extending across the dorsum near the posterior or anal end.

This, too, is a very common and widely distributed species and has been reported from nearly every section of the country.

Specimens were reared from twigs infested with *Macrosiphum citrifolii* Ashm., *Toxoptera aurantiæ* Koch, and *Aphis gossypii* Glover as well as from a great number of infestations of other common aphids.

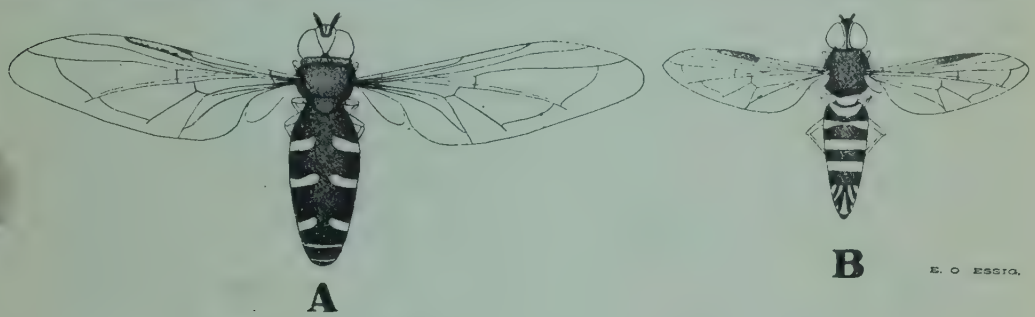

FIG. 130.—A, *Syrphus americanus;* B, *Allograpta obliqua.*

Allograpta obliqua Say. (Fig. 130 B.)

This is the smallest of the three species taken from citrus aphids. It is not as plentiful as either of the two species above, but is by no means rare. Length one quarter of an inch. The body is dark and very slender. Eyes dark red. Face yellow with dark median line. Antennæ amber brown. Thorax iridescent green. Scutellum light yellow. Legs light yellow. Abdomen dark with four transverse yellow bands on the dorsum and yellow longitudinal markings at the base of the ovipositor, which is amber brown or dark.

Reared from *Toxoptera aurantiæ* Koch and *Aphis gossypii* Glover.

Internal Parasites.

Of the natural enemies of the citrus plant lice, by far the most effective are the internal parasites. The adult females of these true parasites deposit their eggs by means of a long, sharp-pointed ovipositor, which pierces the body wall of the lice, within the living tissues, inside the bodies of the plant lice. The outside wound heals over in a short time, leaving the egg tightly sealed within the body ready to hatch. As soon as the egg is hatched the small, legless larva begins to

feed upon the tissues of the aphid and its development means the extinction of a louse. When fully developed and ready to leave the "mummied" louse it cuts a circular hole in the top of the body and escapes a winged insect ready to produce more eggs and to thereby destroy more insects. The life cycle varies according to the time of year. In the colder months it covers from about ninety to one hundred days, while during the summer months it covers from eight to fifteen days.

The so-called "mummied" plant lice (Fig. 131) are easily recognized before the adult parasite escapes by the inflated and discolored bodies which appear among the healthy individuals. These bodies are usually of a lighter color and finally become entirely bleached. The circular

FIG. 131.—Mummied bodies of parasitized plant lice.

hole cut by the escaped parasites is always a sure sign of the presence of these beneficial insects. The "mummies" are fastened to the leaf, as soon as the louse is dead, by the larva of the parasite, which cuts a slit in the lower side of the body and fastens it to the leaf or twig by excreting a mucilaginous or web-like substance for this purpose.

So far, I have been able to collect two distinct forms of these hymenopterous parasites—one a very common Braconid, *Aphidius testaceipes* Cresson, and the other a Cynipid of the genus *Charips* (*Allotria*). Brief descriptions of these insects are as follows:

Aphidius testaceipes (Cresson). (Fig. 132 left.)

1879 *Trioxys testaceipes* (Cresson) Comstock, U. S. Dept. Agrcl. Rept. p. 208. Original description.

1888 *Lysiphlebus testaceipes* (Cresson) Ashmead, Proc. U. S. Nat. Mus. p. 667.

CRESSON'S ORIGINAL DESCRIPTION.

"*Female*—Piceous or shining black, smooth and polished, impunctured; mandibles and palpi pale; antennæ brownish black, sometimes more or less pale beneath, thirteen-jointed, the joints faintly fluted or grooved, the last one longest and thickest; wings hyaline, iridescent, stigma pale; legs, including coxæ, yellowish-testaceous, the posterior

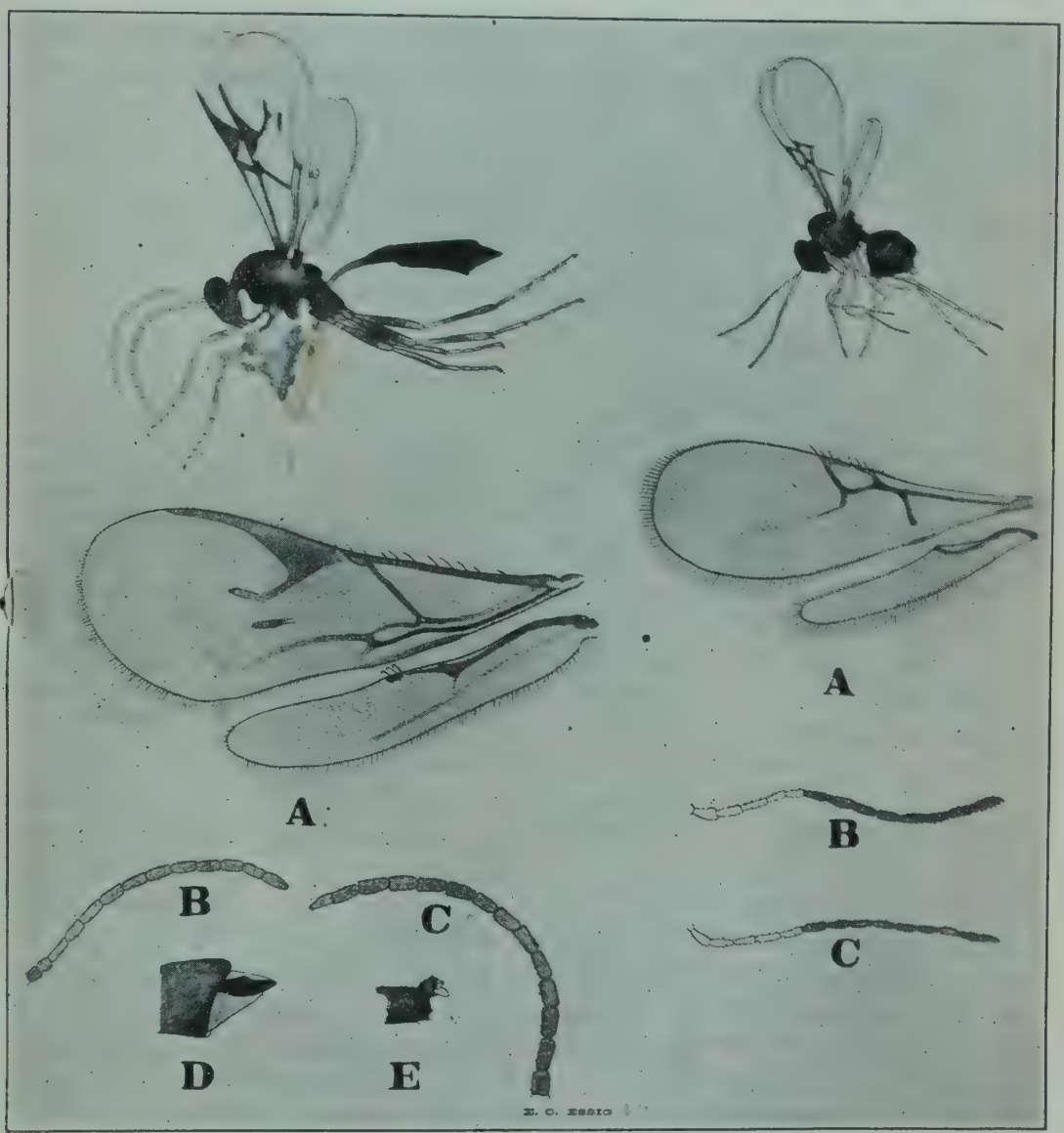

FIG. 132.—*Aphidius testaceipes*, on left; *Charips xanthopsis* on right. A, wings; B and C, antennæ; D, abdomen of female; E, abdomen of male.

pair generally more or less fuscous or blackish; abdomen often brown or pale piceous, with the first, and sometimes part of the second, segment more or less testaceous. Length 0.07 inch.

"*Habitat*—Rock Ledge, Florida; Selma, Ala., and Pocomoke City, Md. Parasitic upon an aphid infesting twigs of orange, an aphid on the cotton plant, and *Aphis avenæ* Fabr."

In southern California this insect is parasitic on *Aphis gossypii* Glover (the orange and cotton aphid) and on *Toxoptera aurantia* Koch. Collected by the writer at Santa Paula, California.

I am indebted to Mr. C. L. Marlatt for the identification of this species.

Charips xanthopsis Ashm. (Fig. 132 right.)

1896 *Allotria xanthopsis* Ashmead, Trans. Amer. Ent. Soc. XXIII, p. 185.

Ashmead described this parasitic cynipid as having been reared from *Siphonophora citrifolii* in Florida. The species we rear here quite commonly from *Aphis gossypii*, and *Toxoptera aurantiæ*, is very near to *xanthopsis*, if not the same thing. Only minute comparison with the type could settle the matter, however.

Remedies for Plant Lice on Citrus Trees.

Though it is seldom necessary to employ artificial means in dealing with these insects, yet any of the forms described may almost entirely overrun young trees. I know of such a case at Claremont in the year 1909, where a young Valencia orange orchard was badly infested and nearly all of the new growth killed back as fast as it grew out. But even greater damage may be done to young buds placed in old trees. On these tender shoots the green louse, *Macrosiphum citrifolii* Ashm., is especially bad, and in such cases should be controlled by sprays.

In using sprays for these aphids, we must first take into consideration the tree and what it can stand. Though the citrus trees are evergreen and do not admit of severe winter sprayings, as do the dormant deciduous trees, yet the leaves are more resistant than are the tender leaves of the latter, and will stand more summer spraying, when it is most necessary for the insects under discussion. So far I have never found any of the aphids depositing eggs to bridge over the winter months. Adult insects, however, may be found in limited numbers throughout the entire year in southern California, so we do not have to deal with a distinct egg-laying stage, which is difficult to handle except with very strong sprays. Neither do we have to deal with root forms, like the underground forms of the Black Peach Aphis (*Aphis persicæ-niger* Smith) and the Woolly Aphis of the Apple (*Schizoneura lanigera* Hausm).

The sprays recommended, then, are such as might be used on citrus trees and are not intended as remedies for aphids on all trees and plants, though many of them are standards and need but little additions of water to serve any purpose.

SPRAY FORMULÆ.

Tobacco Sprays.

Tobacco Decoctions.

(1).	Tobacco stems, dust or waste	2 pounds.
	Water	4 gallons.
(2).	Tobacco leaf	1 pound.
	Water	4 gallons.

Steep the tobacco in the water for one hour and apply in two applications of five days apart.

Commercial Tobacco Sprays.

(1).	Black Leaf Extract	1 gallon.
	Water	30 gallons.
(2).	"Black Leaf 40"	1 gallon.
	Water	1,000 gallons.

By adding one pound of soap to every fifty gallons of these sprays the efficiency is greatly increased.

Tobacco Decoction and Soap.

Tobacco leaves or waste	1 pound.
Water	6 gallons.
Soap	1 pound.

Dissolve the soap in the water and steep the tobacco in this solution for one hour.

Soap Sprays.

Whale-Oil Soap.

Whale-oil soap	1 pound.
Water	6 gallons.

Emulsions.

Kerosene Emulsion.

stock solution.

Kerosene	2 gallons.
Whale oil or laundry soap	½ pound.
Water (must be soft)	1 gallon.

preparation.

Dissolve the soap in hot or boiling water; add the kerosene (be careful of fire); agitate thoroughly with a hand pump until a rather thick, creamy liquid results. (This thorough agitation, by pumping back into the same vessel, is necessary to insure a proper emulsion, which will not damage the foliage.) For use add one gallon of the above stock solution to every twelve gallons of water.

Carbolic Acid Emulsion.

stock solution.

Whale-oil soap	40 pounds.
Crude carbolic acid	5 gallons.
Water to mix	40 gallons.

preparation.

Dissolve the whale-oil soap in the water, heating it to the boiling point (soap must be thoroughly dissolved); add the crude carbolic acid and cook for twenty minutes over a good fire (reserve five gallons of water to add in case the mixture begins to boil over). For use add twenty gallons of water to every gallon of the stock solution. This emulsion needs no agitation while being applied.

Resin Spray.

RESIN WASH.

Resin	10	pounds.
Caustic soda (76 per cent)	3	pounds.
Fish oil	1½	pints.
Water	50	gallons.

Place resin, soda and fish oil in a kettle with water to cover them to a depth of three or four inches. Boil and add water from time to time to make half or a third of the final amount for a stock solution, and for use dilute this according to the above formula.

Quassia Chips and Whale-Oil Soap.

STOCK SOLUTION.

Quassia Chips	1	pound.
Water	1	gallon.
Whale-oil soap	½	pound.

PREPARATION.

Boil the quassia chips in water for one half hour; add the soap and stir until all is dissolved in the boiling water. For use dilute with ten gallons of water.

APPLICATIONS.

It will often be necessary to apply a single spray a number of times in order to get most satisfactory results. These applications should be made at intervals of from four to six days until the insects disappear or greatly diminish in numbers.

One of the greatest successes of a spray is thorough application under high pressure. With a common bucket or knapsack pump only the first can be accomplished, but if even this is observed good results may be obtained. If, however, a power outfit can be had and a pressure of from one hundred to two hundred pounds maintained, one spraying will usually suffice with excellent results. Young buds may not be secure enough to withstand the pressure of a power sprayer, and should be treated with a hand pump.

*CHECK LIST OF CALIFORNIA INSECTS I.

By C. W. WOODWORTH, Professor of Economic Entomology, University of California, Berkeley, Cal.

The following list contains the names that have been applied to California insects, arranged in alphabetical order in their proper families. Where a name is not now considered correct, it is given in italics and the true name indicated.

The list should prove very useful in its present form, but may be considered as provisional and preliminary to a comprehensive report on Economic Entomology, which is in contemplation, to be published jointly by the Agricultural Experiment Station and the office of the State Commissioner of Horticulture.

This report will contain illustrations of all the important groups of insects, synopses for the identification of all genera, and of species in all genera containing important economic insects, including all the important foreign injurious insects, to provide, in short, the means of recognizing and distinguishing between harmful and beneficial or neutral insects.

A full account will also be given of the distribution, habits, life history, and control measures available against the important injurious forms.

The coöperation of specialists and collectors is solicited for the revising of the present list, so that when it appears in the report it shall be as complete and perfect as it is possible to make it. Full credit will be given in the final publication for all assistance of this kind.

LEPIDOPTERA.

PARNASSIIDÆ.

Parnassius *baldur*—clodius.
behrii—smintheus.
clarius—clodius.
clodius Men.
menetriesii—claudius.
nomion (Alaska).
smintheus Edw.

* I do not know of a publication more in demand by the growers and horticultural commissioners in this State than a full and complete work on California insects. It is not uncommon to get requests for such a work from several parties in a single day. This is especially true of the men who are making the study of insect control a valuable asset to the community where they are employed for the protection of the horticultural interests from destruction by insects. The complete check list of all Californian insects, in itself, will be of great value as a means of knowing all the injurious, beneficial, and non-injurious insects which frequent all parts of this great horticultural state. By acquiring such knowledge, the quarantine authorities of the State will know what are already here and what are not to be allowed admission from other states. But the final work, in book form, well illustrated, with descriptions of all existing species, whether native or introduced from foreign countries, will supply the great demand of not only the men in public horticultural service but the progressive and alert fruit grower who desires to become familiar with pests and their control. We believe this to be one of the most important series of articles for the county commissioners and economic entomologists that has ever been published in this State.—*Editor.*

PAPILIONIDÆ.

Euplœdes troilus—Papilio.
Jasoniades daunus—Papilio.
eurymedon—Papilio.
pillumnus (not California).
rutulus—Papilio.
Leartias *arcelisaus* (not California).
mylotes (not California).
philenor (Linn.).
Papilio americanus Koll.
asterias polyxenes.
bardii (Edw.).
californica—zolicon.
celadon Lucas.
daunus (not California).
eurymedon Boisd.
indra Reak.
machaon Linn.
mylotes (not California).
pergamus—indra.
philenor—Leartias.
polyxenes Fabr.
rutulus Boisd.
troilus (not California).
zolicon Boisd.

PIERIDÆ.

Anthocaris angelina—Synchlœ cethura.
ansonia (not California).
ausonides—Synchlœ.
cooperi—Synchlœ cethura.
cethura—Synchlœ.
creusa—Synchlœ.
edwardsii—Synchlœ lanceolata.
hyantis—Synchlœ ansonides.
lanceolata—Synchlœ.
lotta (not California).
morrisoni—Synchlœ cethura.
reakirtii—Synchlœ sara.
sara—Synchlœ.
stella—Synchlœ sara.
Callidryas eubule (Linn.).
Colias adriadne—Eurymus eurytheme.
alexandra—Eurymus.
amphidisca—Eurymus eurytheme.
barbara—Eurymus harfordi.
behrii—Eurymus.
cæsonia—Zerene cæsonia.
californica—Eurymus eurytheme.
chrysomelas—Eurymus occidentalis.
chrysostheme (not California).
edusa—Eurymus eurytheme.
edwardsii—Eurymus.
emelia—Eurymus alexandra.
eurydice—Zerene.
eurytheme—Eurymus.
hagenii—Eurymus eurytheme.
harfordi—Eurymus.
hyale (not California).
interior (eastern).
keewaydin—Eurymus eurytheme.
occidentalis—Eurymus.
phylodice (eastern).
rutilans (undetermined).
scudderi—Eurymus.
wosnesenski—Zerene eurydice.
Eucherra menapia—Neophasia.
Euchlœ ansonoides—Synchlœ.
cethura—Synchlœ.
creusa—Synchlœ.
lanceolata—Synchlœ.
sara—Synchlœ.
Eurema nicippe (Cram.).
Eurymus alexandra (Edw.).
behrii (Edw.).
emelia—alexandra.
eurytheme (Boisd.).
harfordi (Edw.).
interior (eastern).
occidentalis (Scud.).
phylodice (eastern).
scudderi (Reak.).
Gonepteryx rhamni—Zerene eurydice.
Meganostoma cæsonia—Zerene.
eurydice—Zerene.
Midea lanceolata—Synchlœ.
Nathalis iole Boisd.
Neophasia menapia Feld.
terlooii Behr.
Papilio eubule—Callydrias.
cæsonia—Zerene.
nicippe—Eurema.
napi—Pontia.
rapæ—Pontia.
Pieris ansonia (not California).
autodice (not California).
beckeri—Pontia.
calyce—Pontia occidentalis.
castoria—Pontia napi.
chloridice—Pontia beckeri.
flava—Pontia napi.
lanceolata—Synchlœ lanceolata.
leucodice (not California).
marginalis—Pontia rapæ.
menapia—Neophasia.
napi—Pontia.
nausturtii—Pontia napi.
occidentalis—Pontia.
oleracea—Pontia napi.
pallida—napi.
protodice—Pontia.
rapæ—Pontia.
sara—Synchlœ.
sisymbri—Pontia.
venosa—Pontia napi.
yreka—Pontia rapæ.
Pontia beckeri (Edw.).
napi (Linn.).
occidentalis (Reak.).
protodice (B. & L.).

Pontia rapæ (Linn.).
sisymbri (Boisd.).
Rhodocera rhamni—Zerene eurydice.
Synchlœ ausonides (Boisd.).
cethura Feld.
creusa (D. & H.).
flora—sara.
lanceolata (Boisd.).
Synchlœ lotta Beut.
sara Boisd.
Terias midea (undetermined).
mexicana (eastern).
nicippe—Eurema.
Xanthidia mexicana (not California).
Zerene cæsonia Stoll.
eurydice Boisd.

NYMPHALIDÆ.

Adelpha bredowii—Limenites.
californica—Limenites bredowii.
Aglais milberti (Goda).
Agraulis vanillæ (Linn.).
Apatura drummondi Kirby.
Argynnis *adiante*—adiaste.
adiaste Behr.
adraste—adiaste.
aglaja—edwardsii.
arge—eurynome.
atossa Edw.
behrensii Edw.
bellona (eastern).
bremneri Edw.
callippe Boisd.
chitone Edw.
coronis Behr.
cybele—leto.
edwardsii Reak.
egleis Boisd.
egleis—montivaga.
epithore—Brenthis.
eurynome Edw.
hegesia—Euptoieta.
hippolyta Edw.
hydaspe—Zerene.
inornata Edw.
irene—rupestris.
juba—coronis.
laura Edw.
leto Behr.
liliana Edw.
macaria—eurynome.
monticola Behr.
montivaga Behr.
montivaga—irene.
montivaga—egleis
mormoria—egleis.
nenoquis—egleis.
nevadensis Edw.
nokomis Edw.
oweni—hippolyta.
purpurascens—monticola.
rupestris Behr.
semiramis Edw.
zerene Boisd.
Basilarchia archippus Cram.
arthemis (not California).
astyanax (not California).
disippus—archippus.
lorquini (Boisd.).
weidemeyeri (not California).
Brenthis *bellona* (eastern).
epithora (Boisd.).
morrisoni (not California).
myrina (eastern).
nenoquis (not California).
Charidryas carlota (not California).
nycteis (not California).
Chlorippe antoria (not California).
celtis (not California).
leilia (not California).
Eugonia californica (Boisd.).
Eresia hermas (undetermined).
punctata (not California).
Euptoieta claudia (Cram.).
hegesia (Cram.).
Euvanessa antiopa (Linn.).
Grapta c-album—Polygonia oreas.
faunus—Polygonia.
marsyas—Polygonia satyrus.
oreas—Polygonia.
rusticus—Polygonia faunus.
satyrus—Polygonia.
silenus—Polygonia oreas.
silvius—Polygonia.
zephyrus—Polygonia.
Junonia cœnia Hübn.
genovera—cœnia.
lavinia—cœnia.
orythia—cœnia.
Heterochroa bredowii—Limenitis.
californica—Limenitis bredowii.
eulalia—Limenitis bredowii.
Kodiosoma lorquini—Basilarchia.
Lemonias anicia (DeH.).
augusta (Edw.).
baroni (Edw.).
chalcedon (D. & H.).
cooperi (Behr.).
editha (Boisd.).
gabii (Behr.).
hoffmani (Behr.).
macglashani (Riv.).
nubigena (Behr.).
palla (Boisd.).
quino (Behr.).
rubicunda (Edw.).
whitneyii (Behr.).
Limenites bredowii (Hübn.).
culula—bredowii.
lorquini—Basilarchia.
Melitæa anicia—Lemonias.
augusta—Lemonias.

Melitæa baroni—Lemonias.
campestris—Phycioides pratensis.
canace—Phycioides picta.
chalcedon—Lemonias.
callina—Phycioides mylitta.
collina—Phycioides mylitta.
cooperi—Lemonias.
dwinellei—Lemonias chalcedon.
editha—Lemonias.
epula—Phycioides mylitta.
gabii—Lemonias.
gloriosa (undetermined).
helcita—Lemonias hoffmani.
hermes (undetermined).
hoffmani—Lemonias.
leanira—Thesalia.
macglashani—Lemonias.
montana—Phycioides.
mylitta—Phycioides.
nubigena—Lemonias.
obliterata—Thesalia leanira.
obsoleta—Thesalia leanira.
orseis—Phycioides pratensis.
palla—Lemonias.
pratensis—Phycioides.
pola—Phycioides whitneyii.
pulchella—Phycioides mylitta.
pulchella—Phycioides pratensis.
quino—Lemonias.
rubicunda—Lemonias.
sonoræ—Lemonias gabbi.
thekla—Thesalia.
theona—Thesalia.
whitneyii—Lemonias.
wrightii—Thesalia.
zerene—Argynnis.
Nymphalis lorquini—Basilarchia.
Papilio antiopa—Euvanessa.
atlanta—Vanessa.
cardui—Vanessa.
claudia—Euptoieta.
hegesia—Euptoieta.
Papilio huntera—Vanessa.
vanillæ—Agraulis.
Phycioides *canace*—picta.
hermas (not California).
montana (Behr.).
mylitta (Edw.).
orseis—pratensis.
picta (Edw.).
pratensis (Behr.).
tharos (not California).
Polygonia faunus (Edw.).
interrogationis (not California).
oreas (Edw.).
rusticus—faunus.
satyrus (Edw.).
silenus—oreas.
silvius (Edw.).
zèphyrus (Edw.).
Pyrameis atlanta—Vanessa.
cardui—Vanessa.
carye—Vanessa.
clymi—Vanessa cardui.
huntera—Vanessa.
Rhodocera lorquini—Basilarchia.
Thesalia leanira (Boisd.).
thekla (Edw.).
theona (Men.).
wrightii (Edw.).
Vanessa *antiopa*—Euvanessa.
atlanta (Linn.).
californica—Eugonia.
cardui (Linn.).
carye Hübn.
huntera (Fabr.).
marsyas—Polygonia satyrus.
milberti—Aglais.
oreas—Polygonia.
rusticus—Polygonia faunus.
satyrus—Polygonia.
silvius—Polygonia.
zephyrus—Polygonia.

AGAPETIDÆ.

Cercyonis alope (Fabr.).
baroni (not California).
meadii (not California).
oetus (Boisd.).
paulus (Edw.).
sthenele (Boisd.).
sylvestris (Edw.).
wheeleri (Edw.).
Chionobas *californica*—Oeneis nevadensis.
chryxus—Oeneis.
galactinus—Cœnonympha californica.
iduna—Oeneis nevadensis.
ivallda—Oeneis chryxus.
nevadensis—Oeneis nevadensis.
Cœnonympha *brenda*—ochracea.
californica D. & H.
eryngii—californica.
galactina—californica.
inornata (not California).
Cœnonympha ochracea Edw.
pamphilius (Linn.).
pamphiloides—pamphilius.
pulla—californica.
Hipparchia boopis—Cercyonis alope.
sylvestris—Cercyonis œtus.
Libythea bachmanii (not California).
carinenta (not California).
Neominois ridingsi (not California).
Neonympha henshawi (not California).
rubricata (not California).
Oeneis *californica*—nevadensis.
chryxus (D. & H.).
iduna—nevadensis.
ivallda—chryxus.
macounii (eastern).
nevadensis (Feld.).
Papilio alope—Cercyonis.
pamphilius—Cœnonympha.

Satyrus alope—Cercyonis alope.
ariane—Cercyonis alope.
baroni—Cercyonis alope.
boopis—Cercyonis alope.
californica—Cœnonympha.
charon—Cercyonis alope.
nephele—Cercyonis alope.
Satyrus œtus—Cercyonis.
œtus—Cercyonis alope.
paulis—Cercyonis.
silvestris—Cercyonis.
sthenele—Cercyonis.
wheeleri—Cercyonis.

ITHOMIIDÆ.

Ceratinia lycaste—Dynothea.
Dynothea lycaste (Fabr.).
Ithomia lycaste—Dynothea.
Mechanitis californica Reak.
Papilio lycaste—Dynothea.

LYMNADIDÆ.

Anosia plexippus (Linn.).
Danais archippus—Anosia plexippus.
Danais plexippus—Anosia.
Papilio plexippus—Anosia.

RIODINIDÆ.

Apodemia mormo—Chrysobia.
Calephelis australis (Edw.).
nemesis Edw.
Charis australis—Calephelis.
Chrysobia mormo (Feld.).
Chrysobia virgulti (Behr.).
Lemonias australis—Calephelis.
mormo—Chrysobia.
virgulti—Chrysobia.
Nemeobius virgulti—Chrysobia.

LYCÆNIDÆ.

Agriades podarce (Feld.).
Atlides halesus (Cram.).
Brephidium exilis (Bd.).
Callophrys *apama* (not California).
dumetorum (Bd.).
Callipsyche behrii (Edw.).
Chalceria cupreus (Edw.).
Chrysophanes americana (eastern).
arota—Tharsalia.
cupreus—Chalceria.
editha—Gæides.
fasciata (eastern).
gorgon—Gæides.
helloides—Epidemia.
hermes—Tharsalia.
hypophleas (eastern).
mariposa—Epidemia.
virginiensis—Tharsalia.
xanthoides—Gæides.
zerœ—Epidemia.
Cupido ardea (Edw.).
clara (Edw.).
dædalus—icarioides.
fulla (Edw.).
heteronea (Bd.).
icaroides (Bd.).
pheres (Bd.).
phileros (Bd.).
sæpiolus (Bd.).
Cyaniris ladon Cram.
pseudargoilus—ladon.
Epidemia helliodes (Bd.).
mariposa (Reak.).
zerœ (Bd.).
Everes amyntula (Bd.).
monica (Reak.).
tejua (undetermined).
Gæides editha (Barnes).
gorgon (Bd.).
xanthoides (Bd.).
Habrodias grunus (Bd.).
Helodes hypophlœas (not California).
Hemiargus isola (not California).
Hypauratus crysalus (Edw.).
Incisalia *angusta* (eastern).
eryphon (Bd.).
iroides (Bd.).
Leptotes mariana (Reak.).
striata (Edw.).
Lycœna acmon—Rusticus.
amyntula—Everes.
anna—Rusticus.
antiacis—Nomiades.
arota—Tharsalia.
ardea—Cupido.
argyrotoxus—Rusticus anna.
battoides—Rusticus.
behrii—Nomiades antiacus.
cajona—Rusticus anna.
catalina—Phædrotes sagittigera.
cilla—Agriades.
clara—Cupido.
cupreus—Chalceria.
dædalus—Cupido icaroides.
echo—Cyaniris ladon.
enoptes—Rusticus.
erymus—Cupido icaroides.
evius—Cupido pheres.
exilis—Brephidium.
fuliginosa—Satyrum.
fulla—Cupido.
helios—Cupido phileros.
helloides—Epidemia.
hermes—Tharsalia.

Lycæna heteronea—Cupido.
icaroides—Cupido.
lorquini—Phædrotes sagittigera.
lotis—Rusticus.
lupini—Rusticus shasta.
lygdamus—Nomiades.
maricopa—Cupido icaroides.
mariposa—Epidemia.
marina—Leptotes.
mertila—Nomiades antiacis.
mintha—Cupido icaroides.
monica—Everes.
orbitulus (not California).
orcus—Nomiades lygdamus.
pardalis—Cupido icaroides.
pheres—Cupido.
philemon—Rusticus anna.
phileros—Cupido.
piasus—Cyaniris ladon.
podarce—Agriades.
polyphemus—Nomiades antiacis.
pseudargoilus—Cyaniris ladon.
regia—Philotes sonorensis.
rhaa—Phædrotes sagittigera.
rustica (not California).
sæpiolus—Cupido.
sagittigera—Phædrotes.
scudderi (eastern).
shasta—Rusticus.
sonorensis—Philotes.
speciosa—Phædrotes.
striata—Leptotes.
tehama—Agriades podarce.
tejuna (undetermined).
viaca—Phædrotes sagittigera.
xanthoides—Gæides.
xerxes—Nomiades.
virginiensis—Tharsalia.
Metura acis (eastern).
Nomiades antiacis (Bd.).
lygdamas (Doub.).
xerxes (Bd.).
Papilio halesinus—Atlides.
Phædrotes sagittigera (Feld.).
speciosa (Edw.).
Philotes sonorensis (Feld.).
speciosa—Phædrotes.
Polymmatus amyntula—Everes.
antægon—Rusticus acmon.
antiacis—Nomiades.
arota—Tharsalia.
enoptes—Rusticus.
exilis—Brephidium.
gorgon—Gæides.
helloides—Epidemia.
heteronea—Cupido.
Polymmatus hypophleas (eastern).
icarioides—Incisalia.
nivalis—Epidemia mariposa.
pheres—Cupido.
piasus—Cyaniris ladon.
sæpialus—Cupido.
xanthoides—Gæides.
xerxes—Nomiades.
Rusticus acmon (D. & H.).
anna (Edw.).
battoides (Behr.).
chlorina Skin.
enoptes (Bd.).
lotis (Lint.).
neurona Skin.
scudderi (eastern).
shasta (Edw.).
Satyrium fuliginosa (Edw.).
Strymon melinus—Oranotes.
Tharsalia arota (Bd.).
hermes (Edw.).
virginiensis (Edw.).
Thecla acadica—californica.
acis (eastern).
adenostomatis Edw.
augustus (eastern).
auretorum Bd.
behrii—Callipsyche.
blenina (not California).
californica Edw.
chalcis Behr.
crysalus—Hypaurotus.
cygnus—californica.
dryope Edw.
dumetorum—Callophrys.
exolita—nelsonii.
eryphon—Incisalia.
fuliginose—Satyrium.
fulvescens—sæpium.
grunus—Habrodias.
halesus—Atlides.
ilavia Beut.
iroides—Incisalia.
melinus—Uranotes.
mirabelle—ilavia.
muiri—nelsonii.
nelsonii Bd.
pudica—Uranotes melinus.
sæpium Bd.
spadix Edw.
spinetorum Bd.
sylvinus Bd.
tacita Edw.
tetra Behr.
Uranotes *alcestis* (not California).
melinus (Hübn).

HESPERIIDÆ.

Achalarus cellus (not California).
Amblyscirtes ænus Edw.
simius Edw.
Anchyloxypha arene (Edw.).
numitor (not California).
Anthomaster agricola (Boisd.).
nemorum (Boisd.).
practincola (Boisd.).
sylvanoides (Boisd.).
verus (Edw.).
Atalopedes campestris (Bd.).
morrisonii (Edw.).
Atrytone ruricola (Boisd.).
taxiles Edw.
Atrytone melane—Phycanassa.
Calpodes rhena Edw.
Carterocephalus *arene*—Ancyloxypha.
californica—Potanthus dara.
manden—Pamphilia palæmon.
omaha—Potanthus dara.
Cocceius pylades—Eudamus.
Copæodes *arene*—Ancyloxypha.
eunus Edw.
procris Edw.
wrightii Edw.
Epargyreus *exadeus*—Eudamus.
tityrus (Fabr.).
Erynnis cabelus Edw.
columbia—comma.
comma (Linn.).
juba—comma.
manitoba—comma.
oregona—comma.
ruricola—Atrytona.
taxilas—Atrytona.
Eudamus æmilea Skin.
albofasciatus (not California).
exadeus Cram.
mexicana H. S.
nevada—mexicana.
pylades Scud.
sympticius (not California).
tityrus—Epargyreus.
Euphyes *verna* (not California).
vestris (Boisd.).
Hesperia *agricola*—Anthomaster.
cæspitalis (Boisd.).
campestris—Hylephila.
comma—Erynnis.
ericetorum (Boisd.).
melane—Phycanassa.
nemorum—Anthomaster.
pratincola—Anthomaster.
sabuleti—Polites.
ruricola—Atrytone.
scriptura (Boisd.).
sylvanoides—Anthomaster.
sylvanus (European).
syrichtus (Fabr.).
tessellata Scud.
vestris—Euphyes.
Hylephila *campestris*—Atalopedes.
morrisonii—Atalopedes.
phylaeus (Drury).
Lerema deva Edw.
Leroda comus (not California).
Limochroes *cernes*—manataaqua.
manataaqua (Scud.).
phylace (Edw.).
Nisoniades cervantes (European).
funeralis—Thanaos.
propertius—Thannaos.
tages (European).
tristis—Thanaos.
Ochlodes agricola—Anthomaster.
nemorum—Anthomaster.
pratincola—Anthomaster.
sylvanoides—Anthomaster.
verus—Anthomaster.
Pamphilia *agricola*—Anthomaster.
aragos (not California).
cabeus—Erynnis.
campestris—Atalopedes.
colorado—Erynnis comma.
columbia—Erynnis comma.
comma—Erynnis.
errans—Prenes.
huron—Atalopedes campestris.
idaho—Erynnis comma.
juba—Erynnis comma.
manataaqua—Limochroes.
mandan (not California).
manitoba—Erynnis comma.
melane—Phycanassa.
nemorum—Anthomaster.
omaha (not California).
oregona—Erynnis comma.
osceola—vestris.
palæmon Pall.
pratincola—Anthomaster.
phylæus—Hylephila.
ruricola—Atrytone.
sabuleti—Polites.
sylvanoides—Anthomaster.
sylvanoides—Erynnis comma.
sylvanus (European).
taxilis—Atrytona.
verus—Anthomaster.
vestris—Euphyes.
yrcka—Anthomaster nemorum.
Papilio comma—Erynnis.
phylæus—Hylephila.
syrichtus—Hesperia.
Pholisora alpheus Edw.
catullus (Fabr.).
libya Scud.
Phycanassa melane (Edw.).
Polites sabuleti (Boisd.).
Potanthus dara (Kol.).
californica—dara.
Prenes errans Skin.
Pyrgus *cæspitalis*—Hesperia.
erictetorum—Hesperia.
petreius—Hesperia cæspitalis.
ricara—Hesperia cæspitalis.
syrichtus—Hesperia.
tessellata—Hesperia.

Syrichtus cæspitalis—Hesperia.
ericetorum—Hesperia.
ruralis (not California).
scriptura—Hesperia.
tessellatus—Hesperia.
Thanaos brizo B. & L.
cervantes (European).
funeralis S. & B.
icelus (not California).
juvenalis (not California).
lilius Dyer.
Thanaos persius (Scud.).
propertius (Linn.).
tages (European).
tibullus S. & B.
tristis Boisd.
Thorybes æmilea—Eudamus.
bathyllus (eastern).
mexicana—Eudamus.
nevada—Eudamus mexicana.
pylades Eudamus.
Thymelious brettus (B. & L.).

SPHINGIDÆ.

Anceryx ello—Erinnus.
Arctonotus lucidus Boisd.
Celario intermedia (Kirby).
lineata (Fabr.).
Chærocampa procne (undetermined).
Cryptopogon ophthalmicus—Sphynx cerisyi.
Deilephila daucus—Celario lineata.
grafii—Celario intermedia.
intermedia—Celario.
lineata—Celario.
Dilophonota ello—Erinnus.
Erinnus ello (Linn.).
Euproserpinus euterpe (Edw.).
phæton (G. & R.).
Hæmorrhagia senta (Stretch).
thetis (Boisd.).
Hemeris cyanoglossum—Hæmorrhagia thetis.
diffinis—Hæmorrhagia senta.
diffinis—Hæmorrhagia thetis.
palpalis—Hæmorrhagia thetis.
rubens—Hæmorrhagia senta.
thetis—Hæmorrhagia.
thetis—Hæmorrhagia senta.
Hyloicus chersis (Hübn.).
drupiferarum (S. & A.).
lugens (Walk.).
perelegans (Edw.).
sequoiæ (Boisd.).
vancouverensis (Edw.).
Lepisesia clarkiæ—Proserpinus.
phæton—Euproserpinus.
Lethia chersis—Hyloicus.
Lintneria perelegans—Hyloicus.
Macroglossa crata—Euproserpinus phæton.
phæton—Euproserpinus.
Macroglossa senta—Hæmorrhagia.
thetis—Hæmorrhagia.
Pachysphynx modesta (Harris).
Philampelus achemon—Pholus.
Pholus achemon (Drury).
Proserpinus clarkiæ (Boisd.).
Protoparce quinquemaculata Haw.
sexta Johan.
Pteropogon clarkiæ—Proserpinus.
Scsia thetis—Hæmorrhagia.
Smerinthus imperator — Pachysphynx modesta.
modesta—Pachysphynx.
ophthalmicus—Hyloicus vancouverensis.
palidulus—Hyloicus vancouverensis.
Sphynx *achemon*—Pholus.
carolina—Hyloicus.
cerisyi Kirby.
chersis—Hyloicus.
drupiferarum—Hyliocus.
ello—Erinnus.
lineolata—Hyloicus.
lugens—Hyloicus.
modesta—Pachysphynx.
oreodaphne—Hyloicus chersis.
perelegans—Hyloicus.
quinquemaculata—Protoparce.
sequoiæ—Hyloicus.
strobi (not California).
vancouverensis—Hyloicus.
Triptogogon imperator — Pachysphynx modesta.
modesta—Pachysphynx.
occidentalis — Pachysphynx modesta.

SATURNIIDÆ.

Attacus ceanothi—Samia rubra.
polyphemus—Telia.
Calosaturnia mendocino—Saturnia.
Dryocampa riversii (undetermined).
Hemileuca *artemis*—nevadensis.
californica—nevadensis.
electa Wr.
lucina—nevadensis.
nevadensis Str.
neumœgenii Edw.
Platysamia californica—Samia rubra.
Pseudohazis *denudata*—eleganterina.
eleganterina (Boisd.).
shastaensis—eleganterina.
Samia *californica*—rubra.
ceanothi—rubra.
curyalis—rubra.
rubra Behr.
Saturnia *californica*—Samia rubra.
ceanothi—Samia rubra.

Saturnia *eleganteriana*—Pseudohazis.
denudata — Pseudohazis elegan-
terina.
mendocino Behrens.
Telea *ceanothi*—Samia rubra.
eleganterina—Pseudohazis.
polyphemus (Cram.).

SYNTOMIDÆ.

Apistosia multifaria—Ctenucha.
Ctenucha brunnea (Stretch).
corvina—rubroscapus.
harrisii (undetermined).
luteoscopsis—multifaria.
multifaria Walk.
ochroscapsis—rubroscapus.
robinsonii (undetermined).
Ctenucha rubroscapus (Men.).
Glaucopsis rubroscapus—Ctenucha.
Lycomorpha fulgens Edw.
fulvicollis (eastern).
Scepsis *gravis*—wrightii.
packardi Grote.
wrightii Stretch.

LITHOSIIDÆ.

Cisthene faustinula—Illice.
lactea—Clemensia.
nexa—Illice.
Clemensia albata Pack.
Clemensia lactea Stretch.
Illice faustinula Boisd.
nexa Boisd.

ARCTIIDÆ.

Aemilia roseata (Walk.).
Ammalo tenera (Hübn.).
Antarctia proba—Diacrisia vagans.
punctata—Diacrisia vagans.
rubra Diacrisia.
Apantesis arge (Drury).
blakei (Grote).
nevadensis (G. & R.).
ornata (Pack.).
proxima (Guer.).
Arachnis *aulæa* (not California).
picta (Pack.).
Arctia *achaia*—Apantesis ornata.
arge—Apantesis.
blakei—Apantesis.
bolanderi—Apantesis blakei.
caia (Linn.).
dahurica—Apantesis ornata.
docta—Apantesis proxima.
doris—Apantesis arge.
edwardsii—Apantesis ornata.
fuliginosa—Phragmatobia.
geneura—Apantesis nevadensis.
nerea—Apantesis.
nevadensis—Apantesis.
ornata—Apantesis.
shastensis—Apantesis nevadensis.
simplicior—Apantesis ornata.
vagans—Diacrisia.
virginalis—Platyprepia.
Bombyx acreæ—Eustigmene.
caia—Arctia.
deflorata—Ecpantheria.
plantaginis—Parasemia.
virginica—Diacrisia.
Callarctia ornata—Apantesis.
Callimorpha lecontei—Haploa.
Chelonia achaia—Apantesis ornata.
proxima—Apantesis.
sciurus—Isia isabella.
virginalis—Platyprepia.
Cordiosoma fulvum—Kodiosoma.
nigrum—Kodiosoma fulva.
Ctenucha harisii—Pygoctructa terminalis.
robinsonii—Lerina incarnata.
Cycnia tenera—Ammalo.
Diacrisia rubra (Neum.).
vagans (Boisd.).
virginica (Fabr.).
Ecpantheria deflorata (Fabr.).
incarnata—Lerina.
permaculata—Turuptiana.
scribonia—deflorata.
Epicallia guttata—Platyprepia virginalis.
virginalis—Platyprepia.
Euchætes elegans—Pygarctia.
sciurus—Ammalo tenera.
yosemite—Ammalo tenera.
Euprepia blakei—Apantesis.
caia—Arctia.
Euschausia argentata (Pack.).
Eustigmene acreæ (Drury).
albida (Stretch).
Eutrepia acajii—Archia caia.
Euverna clio (Pack.).
Halisidota *agassizii*—maculata.
alni—maculata.
argentata—Euschausia.
californica—maculata.
edwardsii—Hemihyalea.
maculata (Harris).
roscata—Aemilia.
sobrina—Euschausia.
euschansia—Argentata.
Haploa lecontei (Boisd.).
Hemihyalea edwardsii (Pack.).
Hyphantria textor Harr.
Isia isabella (S. & A.).
Kodiosoma fulva Stretch.
eavesii—fulva.
nigra—fulva.
tricolor—fulva.
Leptarctia *albida*—Eustigmene.
albofascia—californiæ.
boisduvalii—californiæ.

Leptarctia californiæ Walk.
decia—californiæ.
dimidiata—californiæ.
fulvo fasciata—californiæ.
lena—californiæ.
latifasciata—californiæ.
Lerina incarnata (Walk.).
occidentalis—californiæ.
stretchii—californiæ.
Leucarctia acræa—Eustigmene.
albida—Eustigmene.
californica—Isia isabella.
isabella—Isia.
permaculata—Turuptiana.
Lophocampa maculata—Halisodota.
Mænas vestalis (Pack.).
Nemeophila cæspitalis—Parasemia plantaginis.
chicorii—Parasemia plantaginis.
clio—Euverna.
modesta—Parasemia plantaginis.
Nemeophila petrosa—Parasemia plantaginis.
rufula—Diacrisia vagans.
scudderi—Parasemia plantaginis.
Noctua arge—Apantesis.
fuliginosa—Phragmatobia.
Parasemia plantaginis (Linn.).
Phægoptera cinnamomea—Aemilia roseata.
quercus—Hemihyalea edwardsii.
salacis—Halisidota maculata.
Phalæna isabella—Isia.
Phragmatobia fuliginosa (Linn.).
vagans—Diacrisia.
Platyprepia virginalis (Boisd.).
Pygarctia elegans (Stretch).
Pygoctenucha terminalis Walk.
Seirarctia clio—Euverna.
Spilosoma vestalis—Haploa lecontei.
Turuptiana permaculata Pack.

AGARISTIDÆ.

Agarista dipsaci—Alypia.
gutatta—Alypia.
langtonii—Alypia.
lorquini—Androloma maccullochii.
mariposa—Alypia.
octomaculata—Alypia.
Alypia *brannani*—Androloma.
conjuncta—Androloma maccullochii.
dipsaci G. & P.
gutatta (unidentified).
langtonii Coup.
lorquini—Androloma.
Alypia *maccullochii*—Androloma.
mariposa (G. & R.).
octomaculata (Fabr.).
ridingsii (Grote).
sacramenti—langtonii.
similis—Androloma maccullochii.
Alypoides bimaculata (H. S.).
Androloma brannani (Stretch).
maccullochii (Kirby).
similis—maccullochii.
Pseudalypia crotchii Edw.
Zygæna octomaculata—Alypia.

NOCTUIDÆ.

Abagrotis erratica (Smith).
Ablepharon absidum—Copablepharon.
Acerra addenda (Sm.).
behrensiana (Harv.).
erythrolita (Grote).
muricina—plusiiformis.
mys Dyar.
normalis Grote.
plusiiformis (Edw.).
pulchella (Harv.).
transparens (Grote).
Acontia *angustipennis*—Therasea.
areli—Tarache.
arizoniæ—Tarache elongata.
behrii—Tarache.
coquilletti—Tarache.
elegantula—Tarache.
flavipennis—Tarache.
Acronycta felina—Apatela.
lepusculina—Apatela.
lupina—Merolonche.
perdita—Apatela.
simplex—Xylomiges.
spinea—Merolonche.
Actinotia stewarti Grote.
Adelphagrotis apposita (Grote).
indeterminata (Walk.).
quarta (Grote).
Admetovis oxymorus Grote.
similis Barnes.
Adonisea languida—Melicleptera pulchripennis.
pulchripennis—Melicleptera.
Aedophron pallens Smith.
Agassizia urbicolor Behr.
Agrotis *abnormalis*—Rhizagrotis.
æncipennis—Feltia.
agrestis—Chorizagrotis.
alticola—Pleonectopoda.
annexa—Feltia.
apposita—Adelphagrotis.
atomarius—Pleonectopoda.
atrifera—Pleonectopoda.
auxiliaris—Chorizagrotis.
brevipennis—Pleonectopoda.
brunneigera—Pleonectopoda.
carissima—Rhynchagrotis.
catenula—Porosagrotis.
clemens—Noctua.
cogitans—Pleonectopoda.

Agrotis *colata*—Pleonectopoda.
costata—Rhynchagrotis.
crenulata—Rhynchagrotis.
cupidissima—Rhynchagrotis.
divergens—Pleonectopoda euroides.
euroides—Pleonectopoda vetusta.
exanidalis—Feltia.
exsertistigmus—Rhynchagrotis.
fauna—Pleonectopoda.
fenisica—Pleonectopoda.
formalis—Rhynchagrotis.
friabilis—Pleonectopoda.
furtivus—Pleonectopoda.
fuscigera—Pleonectopoda.
gagates—Pleonectopoda.
gravis—Feltia havilæ.
havilæ—Noctua.
hellmani—Pleonectopoda.
incallida—Pleonectopoda.
incivis—Peridromia.
inelegans—Rhynchagrotis.
infelix—Pleonectopoda.
infirmatis—Setagrotis.
intrita—Pleonectopoda.
introferens—Chorizagrotis.
lacunosa—Pleonectopoda.
lætula—Rhynchagrotis.
lagena—Rhizagrotis.
lutulenta—Pleonectopoda.
malefida—Feltia.
messoria—Pleonectopoda.
micronyx—Pleonectopoda.
milleri—Porosagrotis.
nostra—Pleonectopoda.
pallidicollis—Noctua.
pyrophiloides—Noctua.
quarta—Adelphagrotis.
quinquelinea—Pleonectopoda.
remala—Pleonectopoda.
remota—Pleonectopoda.
rena—Pleonectopoda.
rufipectus—Rhynchagrotis.
satis—Pleonectopoda.
serricornis—Pleonectopoda.
silens—Pleonectopoda.
spectranda—Pleonectopoda.
tesselloides—Pleonectopoda.
vancouverensis—Feltia.
variata—Rhynchagrotis.
venerabilis—Feltia.
vernalis—Setagrotis.
volubilis—Feltia.
wilsonii—Pleonectopoda.
ypsilon Rott.
Amathes bicolorago (Guen.).
fornica (Sm.).
purpurea (Grote).
Anarta kelloggi Edw.
mimuli Behr.
Annaphila *amicula*—decia.
arvalis—salacis.
aurantiaca—Incita.
danistica Grote.
decia Grote.
Annaphila depicta Grote.
diva Grote.
divinula Edw.
domina Edw.
germana Edw.
lithosina Edw.
mera Harv.
salicis Edw.
superba Edw.
Antaplaga koebelei Riley.
Anytus sculptus Grote.
Apamea lunata—Gortyna albilunata.
Apatela felina Grote.
frigida Sm.
hesperida Sm.
impleta Walk.
lepusculina Guen.
lupina—Marolonche.
mansueta Sm.
marmorata Sm.
pacifica Sm.
perdita Grote.
quadrata Grote.
spinea—Marolonche.
theodori—Polia.
Aporophila yosemitæ Grote.
Arsilonche albovenosa (Goez).
Arthrochlora februalis—Feralia.
Atethmia canescens—Calymnia orina.
Auchmis confusa—Morrisonia.
Autographa albavitta Ott.
biloba Steph.
brassica (Ril.).
falcigera Kirby.
gamma (Linn.).
labrosa (Grote).
ou (Guen.).
pasiphæia Grote.
Axenus *amplus*—arvalis.
arvalis (Grote).
ochraceus—arvalis.
Balsa albopunctella Walk.
Behrensia conchiformis Grote.
Bolina cinis (unidentified).
hadeniformis (unidentified).
jucunde (unidentified).
Bombyx odora—Erebus.
Bomolocha ineusalis—Pleonectyptera.
Bryophila viridata—Jasidea.
Cænurgia adversa (Grote).
Calymnia orina (Guen.).
Capnodes californica Behr.
Caradrina exigua Hübn.
extimia Walk.
glabella—Pyrophila.
leucorena Sm.
miranda Grote.
Carneades acutifrons—Pleonectopoda.
alticola—Pleonectopoda.
atomarius—Pleonectopoda.
atrifera—Pleonectopoda.
bicellaris—Pleonectopoda.
brevipennis—Pleonectopoda.
brunneigera—Pleonectopoda.

Carneades calsius—Pleonectopoda.
cogitans—Pleonectopoda.
colata—Pleonectopoda.
comprescipennis—Pleonectopoda.
divergens—Pleonectopoda.
fauna—Pleonectopoda.
freniseca—Pleonectopoda.
friabilis—Pleonectopoda.
fulda—Pleonectopoda.
furtivus—Pleonectopoda.
fuscimacula—Pleonectopoda.
gagates—Pleonectopoda.
hellmani—Pleonectopoda.
henrietta—Pleonectopoda.
incallida—Pleonectopoda.
incubita—Pleonectopoda.
intrusa—Pleonectopoda.
intrita—Pleonectopoda.
lacunosa—Pleonectopoda.
laminis—Pleonectopoda.
loya—Pleonectopoda.
lutulenta—Pleonectopoda.
mævulus—Pleonectopoda.
messoria—Pleonectopoda.
microynx—Pleonectopoda.
noctuiformis—Pleonectopoda.
nostra—Pleonectopoda.
perfusca—Pleonectopoda.
quinquelineata—Pleonectopoda.
relaxus—Pleonectopoda.
remota—Pleonectopoda.
rena—Pleonectopoda.
satis—Pleonectopoda.
selinis—Pleonectopoda.
serricornis—Pleonectopoda.
silens—Pleonectopoda.
spectandra—Pleonectopoda.
tesselloides—Pleonectopoda.
tocoxæ—Pleonectopoda.
vetusta—Pleonectopoda.
wilsonii—Pleonectopoda.
Catabena lineolata Walk.
Catocala adromache Edw.
adulterata (not authentic).
aholibah Stretch.
aspasia Stretch.
augusta—aspasia.
californica Edw.
cleopatra—californica.
electilis—californica.
faustina Stretch.
francesca—mariana.
fratercula G. & R.
hermia Edw.
hippolytia Edw.
ilia (Cram).
irene Behr.
irene—californica.
jessica Edw.
junctura (eastern).
mariana Edw.
marmorata Edw.
perdita—faustina.
portia—stretchii.
Catocala relicta Walk.
stretchii Behr.
verilliana Grote.
virgilia—irene.
volumina—irene.
zoe—ilia.
Cerma olivacea Sm.
Charadra decora Morr.
extimia Walk.
miranda Grote.
Cheophora blanda—Pseudoglæa.
Chloridea subflexa Guen.
virescens Fabr.
Chorizagrotis agrestis (Grote).
auxiliaria (Grote).
introferens (Grote).
Cirrhobolina mexicana (Edw.).
tetrica (Edw.).
Cissura biformata (Edw.).
scropulosa (Edw.).
subterminâ (Sm.).
Cleoceris curvifascia (Sm.).
elda (French).
rectifascia (Sm.).
Cleophana eulepis—Copicucullia.
occata—Oncocnemis.
Cobaliodes angelicus Smith.
franciscanus Smith.
Copablephron absidum (Harv.).
Copibryophila angelica Sm.
Copicucullia eulepis (Grote).
Cosmia orina—Calypinia.
sambuci—Zotheca tranguilla.
Crimona pallimedia Smith.
Cucullia serraticornis Lint.
solidaginis—Rancora.
Cyathissa pallida Smith.
Dargida procinctus (Grote).
Deva palligera—Panchrysa.
Dianthœcia insolens—Mamestra.
leucogramma—Mamestra.
pensilis—Mamestra.
rufula—Graphiphora.
Dicopis damnalis—Eutolype.
Drasteria cærulea Grote.
Dryobata curvifascia—Cleoceris.
elda—Cleoceris.
rectifascia—Cleoceris.
Epizeuxis lubricolis (Geyer).
Erebus odora (Linn.).
Euharvega carbonaria Harv.
Euherrichia cervina (Edw.).
Eumestleta carmelita Morr.
daria (Druce).
Euplexia lucipara (Linn.).
Eupsephopœctes procinctus—Dargia.
Eurois pluviosa—Hadena.
Euros proprius—Sympistis.
Eustrotia includens (Walk.).
penita—includens.
Euthisanotia brevipennis Str.
Eutolype dramalis (Grote).
perscripta—Lepipolys.
Eutricopsis nexilis—Heliaca.

Euxoa biformata Smith.
flutea Smith.
Fala phycophora Grote.
Feltia æneipennis (Grote).
annexa (Triet).
evanidalis (Grote).
gravis (Grote).
malefida (Guen.).
vancouverensis (Grote).
venerabilis (Walk.).
volubilis (Harv.).
Feralia februalis Grote.
Fruva acerba Edw.
modesta Edw.
Glæa olivata Harv.
Gortyna albilunata (Sm.).
nictitans (Berk.).
sauzalitæ—Ochria.
Graphiphora artholita Harv.
behrensiana—Acerra.
curtica (Smith).
erythrolita—Acerra.
furfurata (Grote).
muricina—Acerra plusiiformis.
normalis—Acerra.
pacifica Harv.
pectinata (Stretch).
perbrunnea Grote.
præses (Grote).
puerilis—Orthedes.
pulchella—Acerra.
rubrica—Xylomiges.
fufula (Grote).
terminata (Smith).
Gyros muirii (Edw.).
Hadena adnixa Grote.
albina Grote.
antennata (Smith).
binotata Walk.
castanea—pluviosa.
centralis Smith.
cinefacta Grote.
cogitata (Smith).
cuculiformis Grote.
cymosa—pluviosa.
devastatrix Brace.
divesta Grote.
evelina French.
genetrix Grote.
genialis Grote.
glorina—Polia.
indirecta Grote.
marina Grote.
mustelina Sm.
occidens Grote.
pausis Smith.
pavia Behr.
pluviosa (Walk.).
rectifascia—Cleoceris.
relecina Morr.
stricta—Mamestra.
tusa Grote.
unicineta Smith.
violacea Grote.
Hecatera laudabilis—Mamestra.
Helia occidentalis—Epizeris lubricolis.
Heliaca diminutiva (Grote).
nexilis (Morr.).
ranunculi—Xanthothrix.
Heliodes angelica Smith.
restrictalis Smith.
Heliosea pictipennis Grote.
Heliolonche modicella Grote.
Heliophana amarylis Smith.
Heliophila dia Grote.
farcta Grote.
heterodoxa Smith.
megadia Smith.
minorata Smith.
oxygale Grote.
palliseca Smith.
Heliosea pictipennis (Grote).
Heliothis armiger Hübn.
diminutiva—Heliaca.
phlogophagus G. & R.
proruptus Grote.
sueta—Mamestra.
Herrichia cervina—Euherrichia.
Heterogramma palligera—Tetanolita.
Himella furfurata—Graphiphora.
Homohadena chorda Grote.
deserta—Litocala sexsignata.
elda—Cleoceris.
figurata Harv.
fortis—Oncocnemis.
Homoptera salicis—Phæcyma.
rosæ—Phæcyma salicis.
rubri—Phæcyma.
Hydrœcia *albilunata*—Gortyna.
angelica—Papipema.
lunata—Gortyna albilunata.
pacifica—Gortyna nictitans.
Hypena californica Behr.
decorata—californica.
modesta Sm.
Incita aurantiacus (Edw.).
Ingura cristatrix—Pæctes.
declinita—Pæctes.
Jaspidia viridata Harv.
Laphygma flavimaculata Harv.
Lepipolys perscripta Guen.
Leucania dia—Heliophila.
farcta—Heliophila.
heterodoca—Heliophila.
minorata—Heliophila.
Leucanitis adumbrata—Syneda.
edwardsii—Syneda.
maculosa—Syneda.
nubicula—Syneda.
ochracea—Syneda.
stretchii—Syneda.
socia—Syneda.
tejonica—Syneda.
Litholomia napæa (Morr.).
Lithophane carbonaria—Xylina.
contenta—Xylina.
gausapata—Xylina.
gresonensis—Xylina.
oregonensis—Xylina.
Litocala sexsignata Harv.

Litosea adversa—Cænurgia.
Lygranthœcia saturata—Schinia.
Lythrodes discistriga Sm.
Mamestra albogutta Grote.
chartaria Grote.
circumcincta Smith.
comis Grote.
crotchii Grote.
cuneata Grote.
davena Sm.
defessa Grote.
discalis Grote.
insolens (Grote).
invalida Smith.
laudabilis (Guen.).
leucogramma (Grote).
minorata Smith.
nevadæ Grote.
niveiguttata—Ulolonche.
noverca Grote.
olivacea Morr.
passa Morr.
pensilis (Grote).
puerilis—Orthodes.
quadrilineata Grote.
quadrata Smith.
radix Walk.
rectilinea Smith.
rubrica—Xylomiges.
stricta (Walk.).
subapicalis—Xylomiges perlubens.
trifolii Rott.
u-scripta Smith.
vetusta—Pleonectopoda.
vicina Grote.
Melanoporphyria prorupta Grote.
Melichleptria *californiensis*—sueta.
celeris Grote.
græfiana Tepper.
perminuta—Pseudotamilia.
prorupta—Melanoporphyria.
pulchripennis Grote.
sueta (Grote).
vacciniæ Edw.
villosa Grote.
Meliopotis *bolina*—jucunda.
cinis—jucunda.
hadeniformis—jucunda.
jucunda (Hübn.).
Merolonche lupina (Grote).
spinea (Grote).
Metalepsis cornuta (Grote).
Morrisonia confusa (Hübn.).
peractua Morr.
Nephelodes mimians Guen.
Noctua *alborenosa*—Arsilonche.
clemens (Sm.).
gamma—Autographa.
havilæ Grote.
luciparia—Euplexia.
lubricans Guen.
nictitans—Gortyna.
oblata Morr.
odora—Erebus.
Noctua pallidicornis (Grote).
pyrophiloides Harv.
rosaria (Grote).
saucia—Peridromia.
sierræ Harv.
Ochria sauzælitæ Grote.
Omia nesæa Smith.
Oncocnemis aqualis Grote.
behrensii Grote.
corusca Smith.
exemplaris (Sm.).
fasciatus Smith.
fortis (Grote).
fragmantis Smith.
hayesi Grote.
major Grote.
menantho Smith.
mirificalis Grote.
occata (Grote).
pophono Smith.
Orrhodia californica Sm.
Orthodes puerilis (Grote).
Orthosia bicolorago—Amathes.
fornica—Amathes.
hamifera—Acerra transparens.
purpurea—Amathes.
Oxycnesis fusmacula (Sm.).
yuma Smith.
Pachnobia cinerascens (Sm.).
cornuta—Metalepsis.
Pæctes cristatrix (Guen.).
declinata (Grote).
Palada scarletina Sm.
Panthea portlandia Grote.
Panchrysa palligera (Grote).
Papæpema angelica (Sm.).
Paragrotis (Pleonectopoda).
Peridromia demutabilis (Smith).
incivis (Guen.).
saucia (Hübn.).
Perigea alfkenii Grote.
falsa (Grote).
mersa (Morr.).
Perigonica angulata Smith.
tertia Dyer.
Perigrapha *behrensiana*—Acerra.
inferior—Acerra plusiiformis.
muricina—Acerra plusiiformis.
normalis—Acerra.
præses—Graphiphora.
prima Sm.
pulchello—Acerra.
transparens—Acerra.
Phæcocyma salacis (Behr.).
rosæ—salacis.
rubi (Edw.).
Phalæna ilia—Catocala.
Phoberia indiscreta (Edw.).
Pleonectopoda acutifrons (Sm.).
alticola (Sm.).
atomaris (Sm.).
atrifer Grote.
bicollaris Grote.
brevipennis (Smith).

Pleonectopoda brunniegera (Grote).
cæcius (Sm.).
cogitans (Sm.).
colata Grote.
compressipennis (Sm.).
fauna (Morr.).
feniseca (Harv.).
fulda (Sm.).
furtivus (Sm.).
fuscigera Grote.
fusimacula Smith.
gagates (Grote).
henrietta (Sm.).
hollemani (Grote).
incallida (Sm.).
incubita (Sm.).
insula Walk.
intrita Morr.
intrusa (Sm.).
lacunosa (Grote).
laminis (Sm.).
loya (Sm.).
lutulenta (Sm.).
messoria (Harr.).
micronyx Grote.
nævulus (Sm.).
noctuiformis (Sm.).
nostra (Sm.).
perexcellens Grote.
perfusca (Grote).
punctigera Walk.
quinquelinea (Sm.).
relaxus (Sm.).
remota (Sm.).
rena (Sm.).
satis Harv.
selenis (Sm.).
serricornis (Smith).
silens Grote.
spectanda (Sm.).
tesselloides Grote.
tocoyæ (Sm.).
vetusta Walk.
wilsonii (Grote).
Pleonectyptera finitima Sm.
incusalis Grote.
secundatis Grote.
subflavidalis Grote.
Pleroma obliquata Sm.
Pleuronectyptera finitima Sm.
Plusia *brassica*—Autographa.
californica—Autographa gamma.
gamma—Autographa.
labrosa—Autographa.
lenzi—metallica.
metallica Grote.
ou—Autographa.
russca—Autographa gamma.
Podagra crassipes Smith.
Polia olorina (Grote).
theodori (Grote).
Porosagratis catenula (Grote).
milleri (Grote).
Pronoctua pyrophiloides Harv.
Prodenia ornithogali Guen.
præfica Grote.
Pseudoglæa blanda (Grote).
Pseudoglossa luborcalis—Epizeuxis.
Pseudorthosia variabilis Grote.
Pseudotamila perminuta Edw.
vanella Grote.
Pyrophila glabela Morr.
Pyrrhia umbria Hübn.
Rancora matricaria Behr.
solidaginis Behr.
Raphia cinderella Sm.
coloradensis Put.
pallula—coloradensis.
Rhizagrotis abnormis (Sm.).
lagena (Grote).
Rhynchagrotis carissima (Harv.).
costata (Grote).
crenulata (Smith).
cupidissima (Grote).
exsertistigma (Morr.).
formalis (Grote).
inelegans (Sm.).
lætula (Grote).
rufipectus (Morr.).
trigona Smith.
variata Grote.
Schinia arcifera Guen.
buta Smith.
intrabilis Smith.
lanul Str.
ligeæ Smith.
ochreifascia—lanul.
packardii Grote.
saturata (Grote).
velaris—lanul.
Scoliopteryx libatrix (Linn.).
Scopelosoma napæ—Litholomia.
Scotogramma densa Smith.
Setagrotis dernarius Smith.
infimatis (Grote).
vernalis (Grote).
Stibadium fulignosa Smith.
Stretchia addenda—Acerra.
behrensiana—Acerra.
erythrolita—Acerra.
inferior—Acerra plusiiformis.
normalis—Acerra.
nye—Acerra.
plusiiformis—Acerra.
pulchella—Acerra.
transparens—Acerra.
Stylopoda cephalica Sm.
Sympistis propius Edw.
Synedoida biformata—Cissura.
scrupulosa—Cissura.
subtermina—Cissura.
Syneda adumbrata Behr.
divergens Behr.
edwardsii Behr.
hadeniformis—Melipotis jucunda.
hastingsii Edw.
howlandii Grote.
maculosa Behr.

Syneda *mexicana*—Cirrhobolina.
nubicola Behr.
ochracea Behr.
perpallida—hastingsii.
socia Behr.
stretchii—howlandii.
tejonica Behr.
Tæniocampa addenda—Acerra.
arthrolita—Graphiphora.
carina—Mamestra.
curtica—Graphiphora.
furfurata—Graphiphora.
pacifica—Graphiphora.
pectinata—Graphiphora.
perbrunea—Graphiphora.
præses—Graphiphora.
puerilis—Graphiphora.
pulchella—Acerra.
rufula—Graphiphora.
terminata—Graphiphora.
Tamila vanella—Pseudotamila.
Tarache *angustipennis*—Therasea.
areli (Stretch).
behrii (Sm.).
coquilletti (Sm.).
elegantula (Harv.).
flavipennis (Grote).
niveicollis Sm.
Tetanolita palligera (Sm.).
Thalpocharea arizonæ—Tarache elegantula.
elegantula—Tarache.
daria—Eumestleta.
Therasea angustipennis (Grote).
Tornacontia meyocula Sm.
Trichoclea *antica*—postica.
edwardsii Sm.
postica Sm.
Tricholita fistula Harv.
Trichosellus cupes Grote.
Trichotarche assimilis Grote.
Triocnemis saporis Grote.
Tristyla alboplagiata Grote.
Ufeus plicatus Grote.
sagittarius Grote.
Ulolonche niveiguttata (Grote).
Veleria opina Grote.
Xanthia *bicolorago*—Amathes.
palæcea Esp.
Xanthothrix neumœgeni Edw.
ranunculi Edw.
Xylina amanda Sm.
carbonaria (Harv.).
contenta (Grote).
dilatocula Sm.
gausapata (Grote).
holocinerea Sm.
indeterminata—Adelphagrotis.
oregonensis Harv.
puella Sm.
torrida Sm.
Xylomiges curialis Grote.
hiemalis Grote.
ochracea Ril.
patalis Grote.
perlubens Grote.
rubrica (Harv.).
simplex (Walk.).
Xylophasia albina—Hadena.
antennata—Hadena.
centralis—Hadena.
cinefacta—Hadena.
cogitata—Hadena.
cuculiformis—Hadena.
genialis—Hadena.
occidens—Hadena.
pluviosa—Hadena.
Yrias crudelis Grote.
Zosteropoda hirtipes Grote.
Zotheca tranquila Grote.
viridula—tranquilla.

GENERAL NOTES.

A PEAR CANKER.

Cankers occurring in the form of concentric rings of cracked bark were sent in from El Dorado County. They appeared to be due to the fungus *Sphæropsis malorum*, as spores of this fungus were found in the bark of the affected part. In the center of the affected spot is a small circle of cracked bark. This is surrounded by larger elliptical

FIG. 133.—Pear canker showing concentric rings of cracked bark. (Essig.)

rings of cracked bark with the longer axis of the ellipse in the direction of the branch (Fig. 133). Professor R. E. Smith refers to this canker under the head of "Curly Bark of Pear" (Bulletin 218, California Experiment Station). Cankers due to the fungus *Sphæropsis malorum* have often been reported on apple, quince and pear trees in the Eastern states. The same fungus also causes a rotting of the fruits known as black rot. The same treatment as given for the two nectria cankers (Page 249) on apples may be used for this one.—H. S. FAWCETT.

THE CHESTNUT TREE BLIGHT.

We wish to thank our many friends for the hearty approval given to the appointment of a Mycologist in the Commission of Horticulture. One only need read the reports from Florida to become assured that no mistake has been made in our selection of a man to fill the important office. Already destructive fungi are costing our fruit growers hundreds of thousands of dollars. Much of this can be saved. But another phase of this question gives even more hearty support to this policy. Recently a fungus attacked the chestnut in the East. This chestnut tree blight is most virulent. Its deadly work should cause us all to pause and take notice, for who of us knows which of our fruit trees will next be victims? It is not known whether this pest is one native to America, which has changed its host, or whether, as seems more probable, it is a foreign foe introduced from Japan, as some think, or possibly from Italy. Whatever research may determine regarding this chestnut tree blight it is very evident that the expert mycologist, who will camp in the field, and attack the enemy right in his lair, is a power in our present day horticultural work. We are to be congratulated that we are meeting these economic problems in just this safe, sane way.—A. J. Cook.

THE FRUIT FLY IN AUSTRALIA.

Mr. P. Duffy, head of the Duffy Fruit Company of Sydney, Australia, and one of the largest exporters of California fruits to the antipodes, arrived here April 30th, per the steamship Wilhelmina. Mr. Duffy joined the Wilhelmina at Honolulu, having arrived at that port direct from Sydney per a Vancouver steamer.

The writer being personally acquainted with Mr. Duffy for the past ten years, and knowing that he had a thorough knowledge of the fruit industry in Australia, and also of the ravages of the Mediterranean fruit fly in that country, inquired, in the presence of other members of the Quarantine Division, as to the conditions of the fruit fly in Australia at the present time. Mr. Duffy answered as follows:

"The fruit fly has been worse this season than ever before, and is rapidly spreading over the country, infesting all sorts of fruits and vegetables." The next question asked Mr. Duffy was, "Are you going to import into California any fruit from sections of Australia where the fly is not known to exist?" "No, sir, I am not: it would be impossible at present to say which section is free from the fly, and I consider that it would be worse than criminal to ship material that would introduce the fly into California, and I do not want to see California's great fruit industry destroyed," was the reply.—Geo. Compere.

PRESERVING FRUITS FOR EXHIBITS.

The establishment of chambers of commerce and development associations and societies for the benefit of the agricultural interests throughout the country has resulted in a large demand for the best possible methods of showing up the various products to the very best advantage. One of the most difficult problems, especially with beginners, is the preservation of the color and bloom of the fruits. In the larger institutions and in some of the smaller ones, the work is being carried on with a high degree of intelligence and with excellent results. Any one who has ever visited the chamber of commerce at Los Angeles cannot but be impressed with the exquisite perfection of its preserved fruits and vegetables. But such exhibits are not universal.

Some years ago the writer had occasion to look into this matter and found that not all of those who knew the various processes were willing to lend any advice and it was with much difficulty that even a hint was gained from the commerce chambers themselves. Fortunately it happened that this matter came up in the presence of a commercial druggist and chemist, who has had a large experience with this very thing, and who gladly sent the desired information. All of the formulæ and directions herein included were obtained through Mr. C. W. Hill, president and general manager of the California Drug and Chemical Company, Los Angeles, California.

It is in response to a large demand for these directions that it has been decided to give them out to the general public. It is to be hoped that if any one has other recipes and formulæ that he will be kind enough to send them to this office, from whence every interested party may be supplied with further directions for putting up California fruits so that they will continue to be just what they were when picked. Surely this is a large way in which to render service of great value to the whole State.

Taken from printed copy forwarded by G. B. Brackett, Pomologist, Bureau Plant Industry, United States Department of Agriculture.

INSTRUCTIONS REGARDING THE PRESERVATION OF FRUITS IN ANTISEPTIC FLUIDS.

(Credit for the formulæ here presented is due Dr. Wm. Saunders, Director of Experiment Station, Ottawa, Canada.)

General Directions.

Select the finest specimens of fruit, both as to form and size. Handle them carefully to avoid all bruising, and place them in bottles, arranging the specimens so as to show them to the best advantage. Fill each bottle to the neck with fruit, then pour on the fluid recommended, filling the bottles to within one half inch of the stopper, so as to entirely cover the fruit; then place the stopper in the bottle and run a little melted beeswax or paraffine over the joint to make it air tight. Tie the stopper down with a strong piece of cotton, and attach to each bottle a label containing the following particulars: Name of the variety of fruit, name and address of the grower, with the state in which the party

resides. Write also in each case in one corner of the label the letter suggested to indicate the fluid which has been used. Wrap the bottles in paper to exclude the light and preserve in a cellar or other cool place until required for exhibit. Strawberries and raspberries should be cut from the plants or bushes with a pair of scissors, leaving a short piece of stem attached to each.

***Fluid No. 1.**

Formalin (formaldehyde), 1 pound (16 oz.); water, 44 pounds; alcohol, 5 pints.

Allow the mixture to stand, and should there be any sediment, pour off the clear liquid and filter the remainder through filter paper.

This 2 per cent solution of formalin, or formaldehyde, has been found very useful for preserving strawberries, so as to give them a natural appearance.

In each case where this fluid is used, mark "F" on one corner of the label.

***Fluid No. 2.**

A solution of boric acid in the proportion of 2 per cent.

Dissolve one pound of boric (boracic) acid in 45 pounds of water, agitate until dissolved, then add 5 pints of alcohol. If the fluid is not clear allow it to stand and settle, when the clear upper portion may be poured off and the remainder filtered.

In each case where this fluid is used, mark "B" on one corner of the label.

***Fluid No. 3.**

A solution of zinc chloride in the proportion of 3 per cent.

Dissolve one half pound of zinc chloride in 15 pounds of water, agitate until dissolved, then add $1\frac{2}{3}$ pints of alcohol. Allow the mixture to stand until settled; then pour off the clear fluid and filter the remainder.

In each case where this fluid is used, mark "Z" on one corner of the label.

***Fluid No. 4.**

Sulphurous acid, 1 pint; water, 8 pints; alcohol, 1 pint.

Allow the mixture to stand, and should there be any sediment pour off the clear liquid and filter the remainder.

In each case where this fluid is used, mark "S" on one corner of the label.

LIST OF FRUITS WITH THE NAME OF PRESERVATIVES TO BE USED IN EACH CASE.

Where two fluids are named either may be used, but the first named is preferred.

Strawberries—Solution No. 1, formalin.
Raspberries, red—No. 2, boric acid, No. 1, formalin.
Raspberries, white—No. 4, sulphurous acid, No. 3, zinc chloride.
Raspberries, black—No. 2, boric acid.
Blackberries—No. 2, boric acid; No. 1, formalin.
Cherries, red or black—No. 1, formalin; No. 2, boric acid.
Cherries, white—No. 4, sulphurous acid.
Currants, red—No. 1, formalin; No. 2, boric acid.

*These fluids are poisonous and should be handled accordingly.

Currants, white—No. 4, sulphurous acid; No. 3, zinc chloride.
Currants, black—No. 2, boric acid.
Gooseberries—No. 1, formalin; No. 2, boric acid.
Apples, green and russet—No. 3, zinc chloride.
Apples, more or less red—No. 2, boric acid.
Apples, white or yellow—No. 4, sulphurous acid.
Pears, russet—No. 3, zinc chloride.
Pears, green or yellow—No. 4, sulphurous acid.
Plums, dark colored varieties—No. 1, formalin; No. 2, boric acid.
Plums, green or yellow—No. 4, sulphurous acid.
Peaches, Apricots, Nectarines or Quinces—No. 4, sulphurous acid; No. 3, zinc chloride.
Grapes, red or black—No. 1, formalin; No. 2, boric acid.
Grapes, green or yellow—No. 4, sulphurous acid.

FORMULA FOR PRESERVING CITRUS AND OTHER FRUITS.

After the fruit has been carefully selected, avoiding that which is blemished or in any way abused, place in the receptacle in which it is to be preserved, cover with clean, clear water, and thoroughly rinse the fruit without removing it from the vessel. Cover it with a preparation prepared as follows:

To every gallon of distilled water add 2 ounces of fresh sulphurous acid. Stir well, pour this over the fruit, covering it at least an inch and a half to two inches.

Set aside in a dark room for thirty days. If any change takes place, such as fermentation or discoloration, pour off the liquid, rinse the fruit and renew the preparation, prepared under the same formula as before.

If after thirty days the fruit still discolors or ferments, it is useless to undertake to carry it through. The only thing to do is to prepare a fresh lot.

This preparation will answer for many other varieties of fruit, provided they have a tough, thick skin. Certain varieties of peaches, pears, and apricots can be successfully prepared under the same formula by adding to the preparation—for peaches and apricots—8 to 10 ounces of glycerine, depending altogether on the amount of sugar contained therein. If you desire to be more accurate as to the amount of glycerine actually required, ascertain the density of the juice of the fruit you desire to put up, and add sufficient glycerine to the water to make its density equivalent to the juices of the fruit.

With this preparation we cannot guarantee the retention of the natural color, as ofttimes the acid destroys the bloom of the highly colored fruit. To obviate this bleaching, we suggest pouring off the liquid after it has stood for five or six days; rinse the fruit in clear water and let it stand for five or six hours; and then renew the preparation; repeating this operation until you are convinced that the color is thoroughly set and the chemical action to destroy the fruit has ceased.

One of the great secrets of keeping fruit under this formula is to keep it in a dark place for from thirty to forty days, in a temperature ranging from 40° to 60°.

When placing on exhibition care should be taken to keep it out of the strong light. In purchasing sulphurous acid be careful that you get the fresh article, and that you get sulphurous and not sulphuric acid.—E. O. Essig.

NOTES FROM THE COUNTY COMMISSIONERS.

Humboldt.

Mr. Weatherby called at the office of the State Commissioner, and reports much progress in the work of his county. Among other things a lively spraying campaign was conducted against the green apple aphis in the most important fruit sections. At the present time there appears to be a marked diminution of this pest over last year.

Imperial.

The control of the date palm scales, *Phenacoccus marlatti* and *Parlatoria blanchardi* occupies much of the time of Commissioner Wilsie. The former scale is by far the more serious and difficult to combat.

Kings.

Commissioner Sharp reports considerable damage to the poplars from a lace bug.

Los Angeles.

Of the five candidates who recently took the examination for horticultural commissioner, all passed.

Mr. Jones, the acting commissioner, is doing what he can to eradicate Black Peach Aphis which has become established in some of the stone fruit orchards.

A frost-fighting organization among the fruit growers is being perfected at Pomona.

Nevada.

Mr. Bree has just finished spraying the pear trees for codling moth in Nevada City and Grass Valley and is now spraying the apple trees for the same pest. He has had five power sprayers operating constantly for over a month and has covered a large territory.

Orange.

Extensive development has taken place in Orange county the last few years. Large areas of lemons, oranges, walnuts and apricots have been planted.

Placer.

The orchards in Placer County are in splendid shape, due to the effective efforts of Commissioner Bowman.

Riverside.

The soft brown scale (*Coccus hesperidum*) is thought by Commissioner Cundiff to be one of the most difficult pests to control that he has to contend with.

San Bernardino.

Extensive plantings of grapes and other deciduous fruits have recently been made in some sections of San Bernardino County.

San Diego.

Commissioner Stuart is engaged in an attempt to clean up some badly infested orchards in his district.

Santa Barbara.

Commissioner Beers has about completed his well-planned work for the success of the Fruit Growers' Convention.

Ventura.

A large planting of lemons this season is reported by Commissioner Vaile.

QUARANTINE DIVISION.

THE QUARANTINE SERVICE.

By Frederick Maskew.

The contingencies of the horticultural quarantine and inspection service of the State of California have developed a type of men, who, judged by all the accepted canons governing such matters, are as a class, placed entirely outside the pale of science, yet by diligent application, by consecutive experience and by exceptionally fortunate opportunities of observation, they have acquired a remarkable fund of systematically arranged knowledge of this particular service, and by continuous practice have developed a technique that has made of them adepts in an art that may be described as a conglomerate of economic entomology, botany and horticulture. A practical working knowledge of the intimate relationship between each of these is what enables the quarantine officer to meet the pressing needs of the hour.

There is nothing that is academic about this quarantine work, or about the rank and file of the workers. It is police work pure and simple, and its efficiency often depends upon the authority to act promptly. *The docks and railroad yards are not the place for research work, for scientific analyses of comparative anatomy or for observing and recording the several phases of life history;* these have their proper place at and are the true functions of the experiment stations.

The quarantine officer, daily called upon to intercept, examine and pass upon trees, plants, fruit and vegetables from all quarters of the globe, must have the common facts indelibly recorded upon his mind ready for instant use. Here is where his combined knowledge of pest, host and locality aids his diagnosis of the fitness or unfitness of the shipment to be granted admittance into the state. In making his decision as to the final disposition of an importation of horticultural products, the action of the quarantine officer is governed by the past record of the disease or insect at hand, or that of its closely allied congeners in its native home, as well as upon whether it exists in the State or not. He is more concerned as to its possible ability to cause real dollars to become transmuted into hydrocyanic acid gas than upon any finely drawn anatomical differences in structure. Being master of the situation he takes no chances, and his actions in these matters in the past have very materially aided in keeping down the cost of crop production in California.

Founded by a man, whose name, wherever trees are grown or fruit is sold, is recognized and accepted as a synonym of fairness and integrity, California has been fortunate indeed in her horticultural quarantine service in the past. Following the precepts and policies of Alexander Craw, his colleagues and successors, pursuing a thankless task, performing a daily duty which compels them to be continually interfering with some one else's business, have by the exercise of tact,

courtesy and dispatch won the respect of by far the great majority of those with whom they come in contact.

The present personnel of the division is thoroughly imbued with these cardinal principles of success in quarantine work, and completely obsessed with the idea that the further protection of the allied agricultural and horticultural interests of California is the one paramount duty for which they are employed. Among these is one who has perhaps the most extensive, practical knowledge of the general appearance, behavior and distribution of the farm and orchard pests of the world possessed by any one person at the present time—*not hearsay evidence, but actual first-hand knowledge*—acquired by personal observation in the native homes of these destructive organisms, during his ten years of exploration for the State of California. This knowledge is the most valuable asset of the division, and, coupled with a practical working knowledge of the quarantine laws, together with the hearty coöperation of transportation companies on land and sea, the United States customs officers along the entire coast line and the county guardians throughout the State, has aroused a spirit of emulation that bids fair to maintain and if possible still further tighten the quarantine lines now drawn around the State.

There has been much valuable work done by this division in past years that has never been fully recognized by the crop-producers of the State in general. This fact is due in the main to the absence of published records in some popular medium. It is further true that popular opinion of this quarantine work considered it as being directed mainly in the interest and for the protection of a few of the leading industries. It is both the desire and the intention of the present administration to show, from time to time through the columns of the "Monthly Bulletin," that while every faculty is being concentrated on excluding the fruit flies, there is no crop being grown in California but that is being protected from the danger of an increase in the cost of production by the work of the quarantine division. As an initial instance we submit the article on the Sweet Potato Stem Borer, page 249.

SOUTHERN CALIFORNIA QUARANTINE.

By A. S. Hoyt.

A comparison of the report of the Los Angeles Quarantine Office for the month of April, with those of the months preceding, shows that the volume of the work as indicated by the number of packages intercepted and inspected, has not decreased with the advancing season. The nature of their contents, however, has very materially changed. The most noticeable instance of this is in the diminution of fruit-tree importations and the increased shipments of ornamental plants and shrubs.

In a review of the month's quarantine work, it might not be out of place to mention an important capture made by Mr. S. A. Pease, Commissioner of San Bernardino County. With characteristic promptness, he disposed of a shipment of jasmine from Mississippi which he found

badly infested with *Aleyrodes citri*. Through the courtesy of Mr. Pease the writer is able to attest by means of personal inspection to the serious nature and extent of this infestation.

San Pedro has shown a steady growth in shipping and in the number of vessels from foreign ports. During the month three ships from Hamburg and Antwerp, via South America and The Horn, and five from Panama have entered the port. These ships, stopping frequently as they do, at points along their course, are constantly liable to bring, by baggage or freight, some quarantined products from Mexico. As a consequence, it is imperative that they be met on their arrival and promptly attended to by the quarantine officer.

Owing to the system installed by Mr. Frederick Maskew, in the work of the southern office, it has been possible to handle the large volume of horticultural imports with the required dispatch. The kindness of the Los Angeles County Horticultural Commission deserves acknowledgment, since all the facilities of their office have been freely placed at the command of the quarantine division.

REPORT FOR THE MONTH OF APRIL, 1912.

By Frederick Maskew.

SAN FRANCISCO DIVISION.

Horticultural imports.	Parcels.
From Honolulu direct—8 ships.	
Passed as free from pests	15,978
Fumigated before releasing	1,573
Destroyed	71
Returned	70
Contraband in ship stores or passengers' baggage	18
Total	17,710
From New Zealand, Australia and South Sea Islands—1 ship	
Passed as free from pests	44
Fumigated before releasing	5
Destroyed	0
Returned	0
Contraband in ship or passengers' baggage	6
Total	55
From China and Japan via Honolulu—4 ships	
Passed as free from pests	1,346
Fumigated before releasing	1
Destroyed	4
Returned	2
Contraband in ship stores or passengers' baggage	15
Total	1,368
From South and Central American, Mexican and Pacific coast ports—19 ships	
Passed as free from pests	11,229
Fumigated before releasing	302
Destroyed	2
Returned	0
Contraband in ship stores or passengers' baggage	3
Total	11,536

Horticultural Imports—Continued.	Parcels.
United States transports from Philippines and Hawaiian Islands—2 ships	
Passed as free from pests	5
Fumigated before releasing	4
Destroyed	1
Returned	0
Contraband in ship stores or passengers' baggage	3
Total	13
By railroads from United States and foreign points:	
Passed as free from pests	37,506
Fumigated before releasing	22
Destroyed	0
Returned	0
Total	37,528
Parcels Post from all points:	
Passed as free from pests	34
Fumigated before releasing	0
Destroyed	0
Returned	0
Total	34

TOTAL FOR THE MONTH OF APRIL, 1912.

Ships	34
Passed	66,142
Fumigated	1,907
Destroyed	78
Returned	72
Contraband destroyed	45
Total parcels of horticultural products for month	68,244

PESTS INTERCEPTED.

From Hawaiian Islands—
- *Dacus cucurbitæ* (larvæ) in cucumbers and tomatoes.
- *Ceratitis capitata* (larvæ) in bell peppers.
- *Pseudococcus* sps. on pineapples.
- *Diaspis bromeliæ* on pineapples.
- *Omphisa anastomosalis* in sweet potatoes.
- *Pseudaonidia* sps. on *Hibiscus*.
- *Lepidosaphes beckii* on crotons.

From Holland—
- *Lepidosaphes ulmi* on boxwood species.

From Japan—
- *Ceroplastes* sps. on *Euonymus* sps.
- *Chionaspis euonymus* on *Euonymus*.
- *Aulacaspis pentagona* on cherry.
- *Lepidosaphes gloverii* on lemons.
- *Parlatoria pergandei* on lemons.
- *Poliaspis pini* on pine.
- Lepidopterous larvæ on boxwood.
- *Jassidæ* sps. on *Arborvitæ*.
- *Diaspinæ* sps. on orchids.
- *Aphis* sps. on water cress.

From Mexico—
- *Lepidosaphes gloverii* on orchids.
- *Chrysomphalus biformis* on orchids.
- *Concaspis* sps. on orchids.
- *Cicada* sps. (eggs) on cocoanut palm.

In looking over the month's work it is a pleasure to know that in the ships of the Matson line and also those of the Oceanic Steamship

Company, not a single specimen of fruit fly material, either fruit or vegetable, was found on these ships or in the possession of any member of the crew arriving at San Francisco. With the ships of the Oriental Steamship Company and those of the Pacific Mail, we were not so fortunate, contraband material infested with maggots being found in the ship stores in both instances. In the matter of passengers' baggage, fruit fly material was detected and destroyed in fifteen instances among those arriving by the various lines during the month.

LOS ANGELES DIVISION.

Horticultural Imports.		Parcels.
From all foreign ports	5 ships	
Passed as free from pests		19
Fumigated		23
Destroyed		0
Returned		0
Contraband in ship stores or passengers' baggage		2
Total		44
From North Pacific ports	14 ships	
Passed as free from pests		95
Fumigated		0
Destroyed		0
Returned		0
Total		95
By railroads from United States and foreign points:		
Passed as free from pests		185
Fumigated		712
Destroyed		6
Returned		3
Contraband		7
Total		913

TOTAL FOR THE MONTH OF APRIL, 1912.

Ships	19
Passed as free from pests	299
Fumigated	735
Destroyed	6
Returned	3
Contraband destroyed	9
Total parcels of horticultural products for month	1,052

PESTS INTERCEPTED.

From Mexico—

Margaronia nitidalis.
Coccus hesperidium.
Chrysomphalus aurantii.
Chrysomphalus scutiformis.
Lepidosaphes beckii.

From Japan—

Pseudaonidia paeonia.
Chrysomphalus ficus.
Ceroplastes ceriferus.
Pseudococcus citri.
Pseudococcus longispinus.
Parlatoria pargandei var. *camelliæ.*
Thyridopteryx ephemeræformis.

From Algeria—

Parlatoria ziziphus.

From Belgium—
Pseudococcus sps.
Diaspinæ sps.
From Eastern States—
Hemichionaspis aspidistræ.
Lepidosaphes beckii.
Chrysomphalus aurantii.
Pseudococcus citri.
Diaspinæ sps.
Borers.

SAN DIEGO DIVISION.

Horticultural imports.

	Parcels.
From Mexico ..... 19 ships	
Passed as free from pests	566
Fumigated	60
Destroyed	11
Returned	0
Contraband in ship stores or passengers' baggage	7
Total	644
By railroads from United States and foreign points:	
Passed as free from pests	2
Fumigated	0
Destroyed	32
Returned	0
Contraband in ship stores or passengers' baggage	0
Total	34
Parcels Post from all points:	
Passed as free from pests	0
Fumigated	1
Destroyed	0
Returned	0
Total	1

TOTAL FOR THE MONTH OF APRIL, 1912.

Ships 19	
Passed as free from pests	568
Fumigated	61
Destroyed	43
Returned	0
Contraband destroyed	7
Total parcels of horticultural products for month	679

PESTS INTERCEPTED.

From Mexico—
Colandra oryza.
Chrysomphalus aurantii.
Aspidiotus sps.
Diaspinæ sps.
From United States and foreign points—
Sanninoidea exitiosa.
Schizoneura lanigera.
Heterodera radicicola.
Crown gall.

FRUIT FLY CONTROL.

FIRST REPORT.

HONOLULU, HAWAII, November 11, 1911.

Chas. S. Judd, Esq., Chairman, Committee on Entomology, Board of Agriculture and Forestry.

DEAR SIR: I beg to submit the following preliminary report in connection with the fruit fly campaign:

Temporary organization.

The area covered by the proposed regulations of the Board of Commissioners of Agriculture and Forestry has for the present been divided up into districts as follows:

District 1. Kalihi Road to Moanalua.
District 2. Liliha street to Kalihi Road.
District 3. Luso street and Pauoa Road to Liliha street, and from School street up Nuuanu Valley.
District 4. Below School street and from Punchbowl street and South street to Liliha street. (This section includes the city, proper.)
District 5. From Luso, Punchbowl and South streets to Piikoi and Pensacola streets, and from Pauoa Road to the sea.
District 6. From Piikoi and Pensacola streets to the McCully Tract and Kalakaua avenue and from the residential foothills of Makiki and Manoa to the sea.
District 7. All the remaining area east of District 6 to Waialae, including Kaimuki and Waikiki.

Of these districts three have been selected for immediate inspection, viz., Districts 3, 5 and 6. Part of District 4 has also received some attention. For the present it has been deemed advisable to divide the last named districts into precincts as follows:

District 3 into 2 precincts.
District 5 into 3 precincts.
District 6 into 3 precincts.
District 4 into 1 precinct.

If it is found that all the precincts in Districts 3, 4, 5 and 6 can be efficiently inspected twice in every week by the present number of inspectors, then it is possible that no radical change in these will take place unless it be during the height of the fruit season, at which time there will have to be a daily inspection of many of the precincts in order to do efficient work.

Inspectors.

On November 1st I appointed the following Inspectors and respectfully request that their appointments be confirmed by the Commissioners and that commissions issue, viz.:

Alex Nelson, third district and part of the fourth.

C. Branco, fifth district.
M. W. Tschudi, sixth district.

On December 1st I purpose appointing a fourth inspector to cover District 4. Unless a much larger appropriation of funds is provided we will not be able to appoint any more than these four inspectors, and later on in the height of the fruit season, the districts will have to be made smaller in order that such inspection as is done can be thorough. The inspectors are required to make daily reports in writing showing conditions as to fallen or infected fruit in their respective precincts.

Appropriation.

Pending the receipt of information from the California authorities as to whether or not they purposed coöperating financially or otherwise with the Territorial Board of Commissioners in the work of suppression or control of fruit fly pests in this territory, I have of necessity had to open the campaign under a supposition that the territorial appropriation of $8,750 was all that would be forthcoming until the legislative session of 1913. For this reason only three inspectors have thus far been appointed. It is needless to say that with such a limited appropriation a continuous and efficient daily inspection of all gardens and orchards in the proposed large quarantined area cannot for one moment be considered. A staff of at least eight or ten inspectors might daily cover a large and important section of said area, but equally important sections could only receive bi-weekly inspection. The most difficult part of the work will naturally be during the middle of the frnit season when the mango, alligator pear, peach and other fruits are abundant. These trees are generally distributed on all premises covered by the regulations. During that period particularly, all gardens, orchards, fruit markets and stalls which now only receive a bi-weekly inspection will need daily attention. If the continuous coöperation of *all* owners or occupants of gardens containing fruit trees was assured or could be relied upon, a bi-weekly inspection of certain sections might result satisfactorily, but there are bound to be sections in the suburbs which will need a very careful daily inspection if this "clean culture" method of control of the fruit fly is to produce results such as California, for instance, would require of us before any of our fruits will be allowed admission into that State. The present season of the year when fruit is not over abundant is the time when occupants having trees in bearing should be over-cautious in stripping their trees and destroying all fallen or infected fruits. The more of this that is done at this time and for the next month or two the better the results later on.

Many owners have already stripped their orange and other trees of ripe fruit. Others have promised to do so. The good fruit can be better utilized at the table than left on the trees until they are either overripe or develop the larvæ of the fruit fly. Many occupants are also destroying an over-abundance of strawberry guava and Chinese orange

trees on their premises, acknowledging that these fruits are particularly a source of danger to other more important fruits because of their susceptibility to attack by the fruit fly. If more residents would only follow suit there would not only be less to fear from fruit fly during the coming season, but much of the daily inspection could be obviated.

I submit the following approximate distribution of the appropriation of $8,750.00 over a period of eighteen months, viz.:

Four inspectors at $325.00 per month, for the four	$5,850 00
To be held in reserve for employment of an experienced economic field entomologist to search for parasites of Mediterranean and melon fly, together with traveling expenses, transportation and incidentals of the department	2,900 00
Total	$8,750 00

Respectfully submitted,

(Signed) W. M. GIFFARD,

Honorary Member Entomological Committee, Board of Agriculture and Forestry, Territory of Hawaii.

FRUIT FLY CONTROL.

SECOND REPORT.

HONOLULU, HAWAII, January 2, 1912.

To the President and Commissioners, Board of Agriculture and Forestry, Honolulu, Hawaii.

GENTLEMEN: I beg to submit the following report as to Fruit Fly Control work for the period ending December 31, 1911, viz.:

Inspection.

In addition to the continued systematic inspection of Districts 3, 4, 5 and 6, bounded by Punahou street on the east and Liliha street on the west, the following have been partly inspected when possible, viz., Districts 1, 2 and 7. These latter areas cover a number of lots in all of which fruit of various kinds is grown, but the distances between the said lots are in many instances far apart and because of this much of the inspection period is wasted in covering each respective district. Until the staff of inspectors is materially increased it will be absolutely impossible to properly inspect not only the three important districts above named but also District 8. This latter takes in the Kaimuki and Kapiolani Park residential areas, a section which is very badly infested.

General conditions in inspected districts.

The destruction of large quantities of fruit (principally sweet and Chinese oranges, loquats, coffee berries and eugenias, etc.), in Districts 3, 4, 5 and 6 has brought about a marked improvement in the inspection of these sections. It is, however, to be regretted that there are still a few residents who do not care to strip their orange and other trees of uninfested ripe or partly ripe fruit. The majority, however, have heartily coöperated and are still doing what they can to assist the work

in hand. If *all* the residents in the above districts worked heartily and hand-in-hand to keep their orange, coffee and other trees entirely stripped of fruit for the next three months there would no doubt be a marked difference in the infestation of mango and alligator pear trees when these come into bearing shortly. Leaving fruit on trees at this season and under the improved fruit fly conditions which at this time exist in the districts above named, only enhances the chances for reinfestation of the whole neighborhood where such fruits are allowed to remain on the trees. Some residents have altogether stripped their trees of the remaining fruits, preferring, if possible, to secure comparative immunity from infestation when their alligator pears come into season, while others do not appear to take any interest in this phase of the situation, preferring, it would appear, to leave their partly ripe fruit on the trees and thereby bring about the reinfestation above ferred to. That a few scattered residents should take this attitude is to be deplored. Fortunately, such people are in the minority, but in sufficient number to cause much extra work because of repeated inspection of their fruit trees. The scarcity of ripe fruit at the present time in the districts named must compel the adult flies to seek hosts in which to breed, and all green or partly ripe fruit left on the trees will in consequence be attacked long before it would be in a condition for use. Such being the case it is regrettable that a wholesale clean up of the balance of the present orange and other crops cannot be inaugurated. Unless the fruit shows signs of infection the inspectors are powerless under the present regulations. On the contrary, should the inspector notice infected fruit on the tree he can and does compel its destruction.

Uninspected districts.

These are situated to the east of Punahou street and to the west of Liliha, viz., Districts 1, 2, 7 and 8, as shown on the map in this department.

The lack of funds to employ additional inspectors has prevented more than an occasional visit to these sections. It is found that all these areas, but more particularly Districts 7 and 8, are badly infected and need immediate and continued attention. Pending the receipt of additional funds which have been promised your Board I have temporarily appointed, with the approval of the president, two additional inspectors to cover the last named districts. These men will commence their duties during the early days of this month, but will have to be laid off on February 1st unless the promised funds are forthcoming. It is to be much regretted that the available funds will not allow of the immediate and permanent employment of a larger staff of inspectors, more particularly as the mango season will be on very shortly and the work of seeing that all fallen fruit is gathered up and destroyed daily will keep a large force busily employed.

General remarks.

The details of the methods and work laid out and now in use by your Director were explained and illustrated to Dr. Wilcox of the Federal Experiment Station, Mr. E. M. Ehrhorn of the Entomological Division of the Board of Agriculture and Forestry, and Mr. O. H. Swezey of the Division of Entomology, H. S. P. A. Experiment Station. These gentlemen were formerly members of the Advisory Committee of which your Director was also a member, and all heartily approve of the present system adopted for the control of the fruit fly within urban and suburban limits. The system referred to has already been fully explained to your Board, and there is no apparent reason to make further reference to it at this time. The system will be improved from time to time as the work goes on or just as soon as all the precinct boundaries can be definitely settled.

The thanks of the Director are due to Dr. Wilcox, Messrs. Ehrhorn and Swezey for assistance rendered in breeding experiments. Up to the present it has been found that among fruits infested with Mediterranean fruit fly are the following: Strawberry and all other garden varieties of guava, peach, Alligator pear, Chinese orange, Mandarin orange, sweet orange, green peppers, fig, rose apple, star apple, mountain apple, coffee berry, wild guava, Chinese plum (*Noronhia emarginata*), mango, overripe papaya, varieties of lime, baby papaya (*Carica querifolia*), *Carissa arduina,* Chinese ink berry, grape fruit, prickly pear, *Eugenia uniflora,* loquat.

On December 26th Mr. Weinland of the staff of the State Horticultural Commission of California arrived from San Francisco. That gentleman has been delegated by the above named commission to represent its interests particularly in reference to the export shipments of all kinds of fruit, including bananas and pines, to the Pacific coast. Mr. Weinland has hardly had time to enter upon any special line of work, but will no doubt do so very shortly. He is also expected to coöperate with the special line of campaign work now under the supervision of your director.

Respectfully submitted,

(Signed) W. M. Giffard,
Director Fruit Fly Control.

FRUIT FLY CONTROL.

THIRD REPORT.

HONOLULU, HAWAII, February 5, 1912.

To the President and Commissioners Board of Agriculture and Forestry, Honolulu, T. H.

GENTLEMEN: I beg to submit a report of the work in the "Fruit Fly Control" for the month ending January 31, 1912, viz.:

Inspection.

Upon request the president authorized me to engage two more inspectors at the beginning of January and in consequence I have been able to thoroughly inspect the areas covered by our outlying Districts 1 and 2 to the west, and 7 and 8 to the east, of Honolulu. Last month I reported these sections as badly infested with fruit fly, but am now pleased to report that strenuous destruction of infected fruits has shown a marked improvement in all these four districts. Continued inspection in all the precincts of Districts 3, 4, 5 and 6 has met with excellent results. Were it not for a few scattered residents who apparently refuse to coöperate in the clean culture methods adopted by your Board, and some others who throw all the burden of the work of picking and destroying infested fruit upon the inspectors, the present conditions would be still better than they are. On the whole, however, all the districts have been fairly well cleaned up of the ripe fruits, etc., of the season. Among these are principally the Hawaiian orange, Chinese orange, Mandarin orange, guava, lime, loquat, carambola, fig, green pepper, coffee berry, Kamani seed, papaya, Eugenia and others. The mango season will be on very shortly, a number of trees already showing large sized, green fruit. Judging from the flowering and setting of the fruit on the mango throughout this island, I should say that the crop is going to be an unusually large one. It will be interesting to see whether or not, because of clean culture methods, the fruit this year will show a diminution of fruit fly attack over that of last year. As previously stated, were it not that there are residents scattered throughout each precinct who cause continued inspection on their premises and fail to coöperate, the chances of reinfestation would be minimized. With such doubtful conditions, however, the reinfestation of small areas may during the mango season cause altogether unnecessary fruit fly conditions in adjacent sections. Many poor tenants of the smaller fruit and vegetable gardens have given us much extra work because of their inability to secure and pay laborers to gather and destroy quantities of infested fruits and vegetables. In such cases as these I have had to double up the inspectors so that these might assist such tenants in picking and carting away quantities of the infested material to the incinerator.

Finances and pay rolls.

Since my last report advices have been received from the State Horticultural Commissioner of California that the sum of $4,000 was available from his appropriation for the period ending July 1st for the purpose of employing inspectors. Your director has satisfactorily arranged with Mr. Weinland, the representative of said Horticultural Commissioner, a system whereby the expenditure of the California funds will be kept separate from that made from our own appropriation. An accounting from this special fund represented by the pay roll, will be forwarded by Mr. Weinland to the California authorities monthly. As it is particularly required that these special expenditures shall not include incidental expenses, these latter will have to be expended from our own appropriation. The incidental expenses, which so far have been principally for printing, advertising and office supplies, will from now on be largely increased, as it will undoubtedly be necessary to do considerable hauling of fallen fruit from certain districts to the incinerator. The districts referred to are of course those situated outside of the county garbage limits. In view of the above facts our own pay roll will show a proportionately less number of inspectors than that of California, but on the other hand the incidental expenses will for a season be much larger than heretofore. Since my last report two additional inspectors have been appointed, the total number on February 1st being 8. Five of these are on the California pay roll and three on our own.

Breeding experiments.

Since last report the Entomological Department has succeeded in breeding the Mediterranean fruit fly from the fruit of carambola and brown persimmon. In the latter case a single fruit was handed us, it having been the only one maturing on a newly introduced species. The above fruits therefore may now be added to the long list of those which we have found to be attacked by Mediterranean fruit fly.

I am sorry to report that on the 31st we bred out the Mediterranean fruit fly from Chinese oranges which I received from a resident in the Hohala district on Hawaii. This is the first authentic knowledge we have of the absolute establishment of this fruit fly on that island, although we have of course known that the common melon fly which has been in the territory for so many years was established on all the islands. The fact that the Mediterranean fruit fly is now already in one district, and possibly in others on Hawaii, will make the system of inspection at ports of destination a much more laborious one, as "clean culture" methods, together with a systematic district inspection, will have to be added to that which was originally contemplated. This also applies to Molokai and Kauai, where I reported a while ago that the fruit fly had already become established. So far we have not received any questionable material from the island of Maui, although it may be possible that the fly has established itself there as well as on the other islands. It is to be regretted that no funds were available to start the

insular port inspection when it was first suggested by me two or three months ago. Failing a sufficient appropriation to efficiently carry out such necessary inspection work as was required to keep the other islands free from infestation, I made an appeal to certain people who are largely interested in diversified industries on Maui and Hawaii with a view to having them "get together" and provide funds to meet the necessary expenses incurred for this insular port inspection. This appeal was made verbally and in writing some weeks ago, but so far I have heard of no serious organization on the part of these agriculturists. As regards the infestation in the Kohala district I would state that I am writing to a prominent resident in that district informing him of the methods to be adopted to keep all fallen and infested fruit picked and thoroughly destroyed daily. I shall also ask him to give as much publicity to the instructions sent as is possible in a country district. It is quite possible that if the infestation is confined to Kohala, and is of only recent occurrence, that radical measures, such as stripping of all fruit trees, including wild guava, may delay its advent in other districts on Hawaii. Certain fruits sent us from Kona and Hilo have so far failed to breed out the Mediterranean fruit fly, although there is one very questionable case, which, when the breeding is complete, may prove to be an infestation of the Kona district. It is, however, somewhat early to predict on this particular case.

Respectfully submitted,

(Signed) W. M. GIFFARD,
Director Fruit Fly Control.

EDITORIALS.

INSPECTION OF NURSERY STOCK PASSING THROUGH THE MAILS.

Economic entomologists all over the United States are much pleased with the new ruling of the Post Office Department relative to the inspection of all plants and nursery stock, before they are admitted into the mails. The ruling is as follows:

> "8. Nursery stock, including field-grown florists' stock, trees, shrubs, plants, vines, cuttings, grafts, scions and buds (which may carry injurious insects) may be admitted to the mails only when accompanied by a certificate from a state or government inspector to the effect that said nursery stock has been inspected and found free from injurious insects."

The question naturally arises, how is this to be done? It is not within the province of this office to answer this question, but no doubt provisions are to be made for the enforcement of the act. The ruling is so worded that the responsibility is placed entirely upon the shipper. If the plant *is not accompanied* by a certificate of inspection it cannot be admitted to the mails. This is enough to prevent the mailing of injurious insects or diseases. In freight and express shipments the inspection is made at the other end and is the source of great confusion and controversy if found infested with injurious diseases or insect pests. In most of the counties of this State the county commissioners and their inspectors are only too willing to comply with this regulation in order to protect the fruit interests of the State, because of the reciprocal way in which it will prevent the introduction of most serious pests from other parts of this country. Surely all connected with the horticultural work of the State will do all in their power to make the above order a working realization.

Concerning the above ruling, Dr. E. P. Felt, editor of the Journal of Economic Entomology, states: "The above restrictions upon transmission of nursery stock through the mails are essential if we are to prevent the dissemination of injurious insects and fungous diseases. There has been complaint for some years respecting this phase of the traffic, and all interested in conserving our agricultural interests can not but welcome this much needed restriction."

PUBLICATIONS OF THE COUNTY COMMISSIONERS.

The work of the county commissioner has grown to be one of the greatest commercial assets of the fruit interests of California to-day. In a state so diversified in climate, soils, and general conditions as this, there is room for an unlimited amount of local research work. That this is being done by the county commissioners is evidenced by the publications which are constantly issuing from various offices.

We are just in receipt of splendid works from Commissioners Earl Morris of Santa Clara, W. H. Volck, Santa Cruz, and Richard Baird of Inyo. It will be remembered that Commissioners C. W. Beers of Santa Barbara, H. H. Bowman of Placer, C. B. Weeks of Tehama, C. R. McBride of Solano, H. P. Stabler of Sutter, Geo. Harney of Yuba, and many others, have placed special printed matter relative to the particular conditions of their counties, into the hands of the growers. These bulletins and press notices have been of the highest order and are justly classed with the best that has been done in economic entomology. The State office appreciates and recognizes this large service and wishes to see it extend to all the counties. The large numbers of cuts belonging to this office are available to all county commissioners free of charge. Such loans will make the costs of illustrating almost nothing.

BRITISH COLUMBIA AND FRUIT FLY.

The effort early put forth by Dr. Cook to secure a uniform quarantine against the fruit fly by all Pacific coast states and counties has borne fruit.

Oregon and Washington are lending loyal support to the national quarantine law.

British Columbia is not far behind California in the protection of its horticultural resources, as the following letter indicates:

VICTORIA, May 3d, 1912.

A. J. Cook, Esq., State Commissioner of Horticulture,
Capitol Bldg., Sacramento, California.

DEAR SIR: I thank you very much for your kind letter of recent date in which you state that you are forwarding a copy of your monthly bulletin No. 1.

We assure you that our Dominion and Provincial governments are very anxious to do their share to prevent the importation of the fruit flies. To be absolutely on the safe side our Dominion Government is issuing an order preventing the importation of any kind of fruit from Hawaii.

Yours very truly,

(Signed) R. M. WINSLOW,
Horticulturist, Department of Agriculture.

Surely such coöperation from our northern friends is encouraging.

A VALUABLE QUARANTINE OFFICER.

In the article entitled "The Quarantine Service" by Frederick Maskew, Chief Deputy State Quarantine Officer, which appears in this issue, special attention is called to the valuable knowledge of a member of the San Francisco office. The person mentioned has performed such efficient service for the State of California, and is so well known that his name need not be omitted here. He is Geo. Compere—a man who has obtained a rare knowledge of the Mediterranean fruit fly all over the world through his travels for beneficial insects. So satisfied is Mr. Compere of the seriousness of this pest that his one aim in life now is to prevent the introduction of the fruit fly into California. He, more than any other single person, is responsible for the quarantine order which was our first barrier against the introduction of infested fruits from localities where the fruit fly exists.

The present personnel of the State Quarantine Division at San Francisco is a rare combination. All three men, Mr. Maskew, Mr. Compere and Mr. Whitney, have worked in the State service together for years, and a more loyal, conscientious and hard-working group of men is unknown.

THREE DESTRUCTIVE DISEASES OF THE PEACH.

Peach Yellows, Peach Rosette, and Little Peach.

By E. O. Essig.

Since the year 1891, when Mr. B. M. Lelong, Secretary of the State Board of Horticulture, issued a printed warning to fruit growers concerning peach yellows, the horticultural authorities of the State of California have maintained a strict quarantine on the diseases known as peach yellows and peach rosette. That their labors have not been in vain is shown by the fact that to date there is no knowledge of the existence of these diseases in this State, though the peach industry has been important here for many years. Nor is the State Commission alone responsible for this fact. Much credit is due to the many competent and vigilant county commissioners, who have watched the interests of their counties to the extent of keeping out the diseases under discussion. Every year there seems to be a renewed determination on the part of these commissioners to continue this good work, for there is no end of questions constantly coming into the office asking for information relative to the distribution of these diseases, so that they may know what stock to quarantine against and what stock to admit. It is because of these requests that this office has begun a revision of the old maps and herewith presents new charts showing to our best knowledge the distribution of the yellows, rosette and also little peach, a similar disease. We are indebted to the Agricultural Experiment Stations in the different states and to the Bureau of Plant Industry of the United States Department of Agriculture for the data presented. The brief descriptions are compilations from Bulletins of the Bureau of Plant Industry, particularly those of Erwin F. Smith, as well as bulletins from the experiment stations of Missouri, Virginia, New York and New Jersey. Bulletin No. 226, by Maurice A. Blake, of the last station, has been a source of much valuable information concerning peach yellows and little peach.

In preparing the maps showing the relative distribution of these diseases, we have followed the directions as presented in the letter from Dr. B. T. Galloway, Chief of the Bureau of Plant Industry, which is printed in full further on. This is true only of peach yellows and peach rosette. As it is impossible to designate every small individual affected locality, it was thought best to simply outline the edges of the infested area and to fill in, even though there are some states within the diseased-represented area which do not report the diseases at all, or where the diseases, if present, are of no economic importance. Such are the cases of Missouri and Kentucky with reference to the yellows.

No doubt there has been a slight confusion with regard to the exact identity of each disease, and little peach may have been reported instead of rosette or yellows, and *vice versa*, but on the whole I believe that the material is thoroughly reliable and can be used as a basis of operation by our county and state horticultural commissioners and inspectors.

Furthermore, it is to be remembered that, though an entire state is indicated as infected, only the peach-growing sections are to be considered as stated in many of the letters from the various experiment stations.

We trust that any errors will be corrected as soon as possible and that any changes or additional information will be forwarded to this office. Your coöperation is desired to see that no injustice is done to any section or locailty and that infested areas not so recorded will be added to what we now know.

As an introduction to the correspondence received and to acquaint our California growers with the most important facts concerning these diseases, a brief description of each follows.

PEACH YELLOWS.

History.

The oldest and without doubt the most destructive of the diseases under discussion is peach yellows. It was probably first observed in Pennsylvania about the year 1791 and has been distributed from this point to its present area. Though the distribution has been somewhat slow it has been constant and gradual, so that we may expect that, unless constant vigilance is maintained by state and county authorities, sooner or later this disease will appear in the peach-growing sections of our own State.

Destructiveness.

This is, according to many authorities, the most destructive disease affecting the peach known in our country to-day. In many localities it has almost entirely wiped out the peach industry, especially before its nature was well understood and scientific care was taken to remove it from the orchards. During the year 1902 there was a loss of 60 per cent in the peach counties of Ohio, outside of Lucas, Ottawa and Erie counties. From 1903 to 1906 there was a loss of 90 per cent in not a few of the peach-growing districts in West Virginia.

Though these losses are great, it is a well confirmed belief among scientific experts that with proper inspection of nursery stock in the nurseries and a strict vigilance on the young orchards, employing all the while stringent measures, that the damage actually done by the disease can be kept down to a comparatively low figure.

Distribution (Fig. 135).

There is considerable confusion as to the exact distribution of peach yellows. This is probably due to the more or less obscureness of the malady as well as the liability to confuse yellows with rosette and little peach. Some authorities claim it is in a locality which is claimed free by others. So at best I have been able to arrive at only an approximate conclusion in the matter. But, basing these conclusions upon the material and information received from so many reliable sources, it is safe to say that the disease does occur in the following localities without the least doubt: Southern Michigan, southern and eastern Kansas,

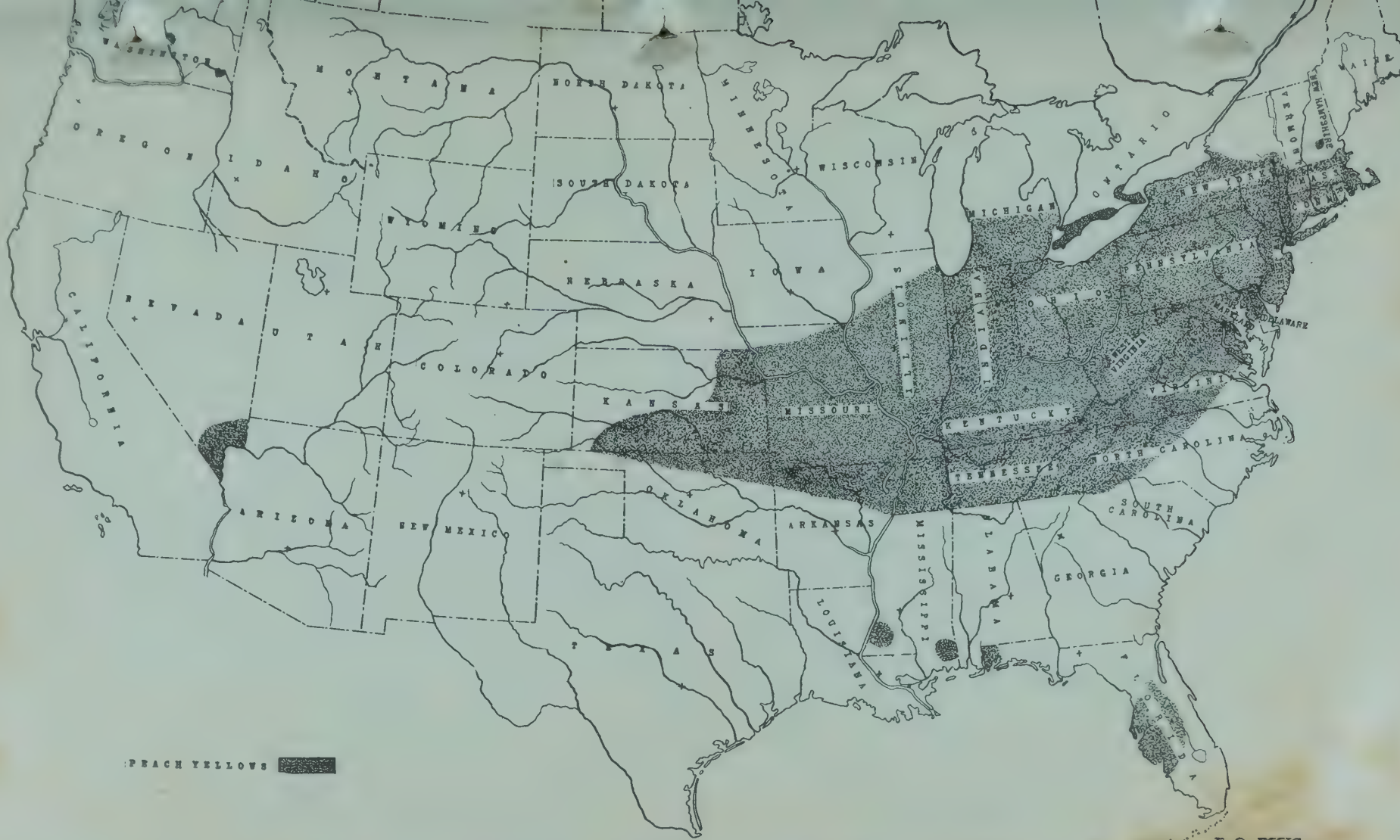

FIG. 135.—Map showing the distribution of peach yellows. (Original.)

in the peach-growing sections of Indiana, Illinois, northern Arkansas, throughout Tennessee, West Virginia, Ohio, Pennsylvania, New Jersey, Connecticut, Rhode Island, Massachusetts, the southern portion of New York, the northern two thirds of Delaware, nearly all of Maryland, practically all of Virginia west of Richmond, the western half of North Carolina, and in the Province of Ontario along the south and west shores of Lake Ontario in the vicinity of Niagara, and also along the north shore of Lake Erie. Yellows (according to Dr. B. T. Galloway of the U. S. Bureau of Plant Industry) also probably occurs in the northern portion of South Carolina, the northern extremities of Oklahoma, throughout many of the peach growing sections of Missouri and Kentucky, though the malady may not be serious in these localities. Mr. Charles Brooks reports one infestation in New Hampshire, and Prof. H. S. Fawcett reports the probable occurrence of the disease in two sections of Florida. Since making up the maps the disease has also been reported as occurring near Natchez along the Mississippi and near Pascagoula on the Gulf in the State of Mississippi.

Plants Attacked.

The trees which are primarily affected by the disease are all varieties of peaches and nectarines. But besides these the disease also works on almonds and apricots. Bailey reports yellows as attacking Japanese plums (Bulletin 75, Cornell Agriculture Experiment Station, page 406. 1894).

Nature and Symptoms (Figs. 134 and 136).

The exact cause of peach yellows is not known, and a discussion of this phase will not be entered into here.

Perhaps the most noticeable symptom of the disease is the premature ripening of the fruit, which usually occurs several weeks in advance of that on healthy and normal trees. This premature fruit (Fig. 136) may appear only on one branch or one side of a tree, or in more advanced cases may be found on all parts of the tree. The fruit is very characteristic in its coloring and flavor. The color varies from a pale to a rich blush, and is more or less red and purple spotted on the skin and blotched or streaked within, as shown in Fig. 136. The flavor is insipid. The spotting of the fruit as well as its premature ripening readily distinguishes yellows from either little peach or peach rosette. The fruit is very susceptible to brown rot and under favorable conditions to the growth of the latter it decays very rapidly.

Trees affected with peach yellows usually develop a diseased-looking, dwarfed growth upon trunks and limbs. These growths bear small, pale-green, yellowish, reddish or white leaves. Often there is a double or repeated branching, and many such sets may develop within a few months and retain their leaves late in the season long after the normal leaves have fallen. The disease usually first appears on one limb or on one side of the tree. The second year is marked by dwarfed shoots which bear foliage of a sickly green color tinged with yellow or brown. After a few years such affected trees assume this color and aspect

throughout all parts. Those seriously affected may die the second year, while many may languish for a number of years, dying gradually from the extremity of the branches downward. The rootlets also die.

On young trees before fruit is borne the symptoms of yellows are not so easily detected except by an experienced observer. If the leaves

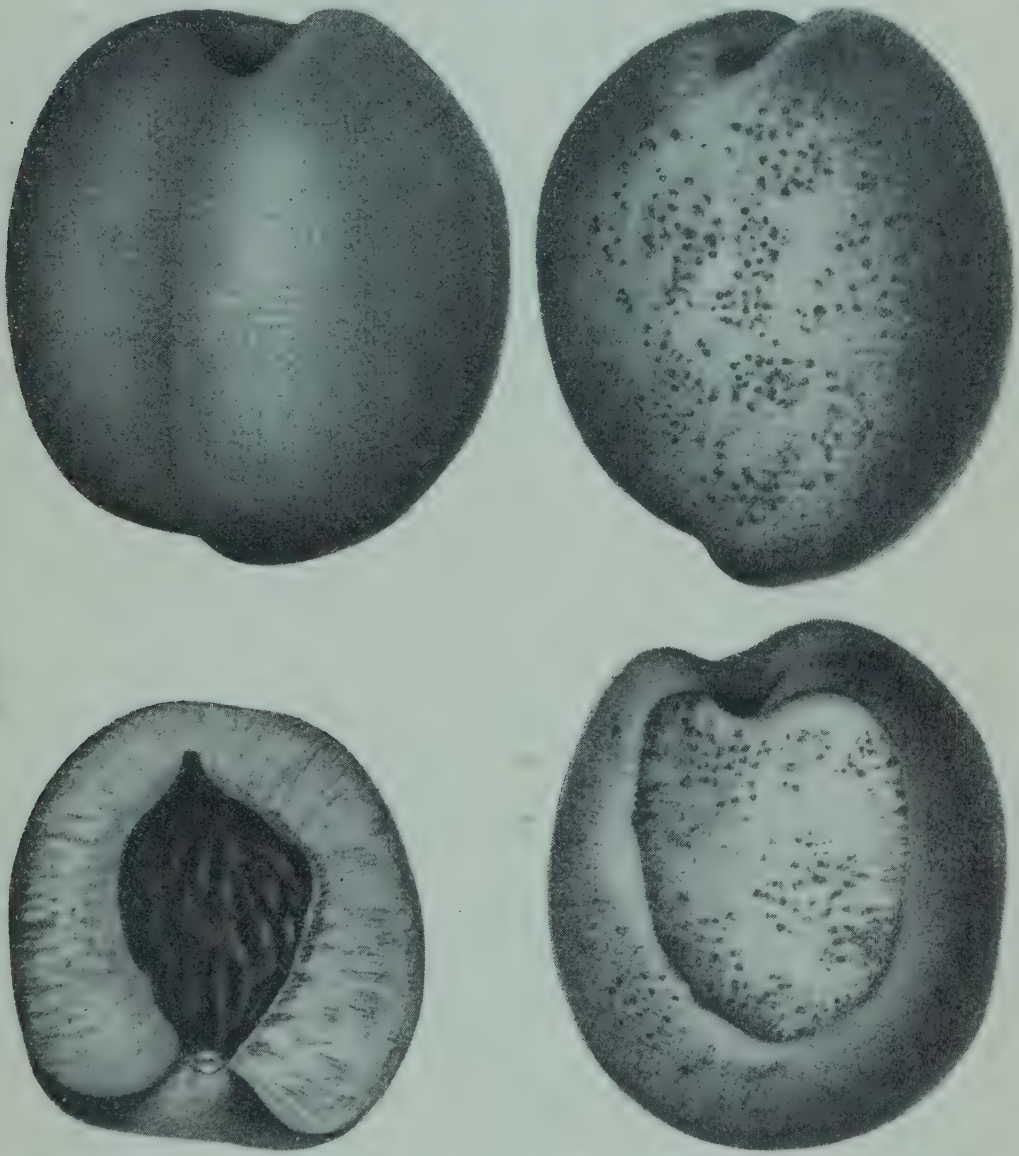

FIG. 136.—Fruit showing effects of peach yellows. The upper left-hand peach is a healthy specimen; the upper right-hand peach shows blotches on the outside skin; the lower right-hand section shows a portion of the fruit removed to show the stains and blotches on the inside; the lower left-hand section shows blotches around the pit. All the spots and blotches are red, while the rest of the fruit is usually yellow. (U. S. Dept. Agrcl.)

on one branch appear yellowish green or reddish rusty green, and roll from the edges there is an indication of the presence of yellows. These leaves will mature early and fall much in advance of the normal foliage. On a diseased tree the fruit buds are matured in advance of those on a normal tree, the bark will appear riper and the lenticels larger. Trees so affected bloom earlier in the spring. The leaves in the center of the

top will appear yellowish green and roll from the edges toward the midrib, and may also droop downward. Such a condition may also indicate little peach, but more often yellows. In any case the tree should be destroyed immediately. Early stages of yellows are difficult to determine in a neglected or poorly managed orchard, as the foliage may be off color on all of the trees. Weak trees are more susceptible to yellows than are healthy ones, so it is important to keep the orchard in good condition.

Modes of Distribution.

Though the exact nature of yellows is not known the evidence that the disease is communicated from diseased to healthy trees is well established. Inoculation experiences have proved this beyond a doubt. Thus diseased buds whenever they can be made to unite with healthy stock always produce yellows, though it may take several years for the true symptoms of the disease to develop.

The disease may be distributed by means of nursery stock coming from a place where yellows exists, and especially from diseased seedlings which have been budded. Concerning this point, Mr. Phillips gave this statement before the American Nurserymen's Association at Milwaukee, Wis., June 12th, 1908:*

"The above facts prove conclusively to my mind that the contagion comes into the nursery both through the pits and the buds used in propagating nursery stock.

"I have so often observed seedlings growing under trees badly diseased with peach yellows as to make me confident that a few diseased pits germinate. Actual experiments, made during the past eighteen months, also show that at least a small per cent of the pits from premature peaches taken from yellows trees germinate."

Budding or grafting seedlings grown from diseased pits will naturally produce diseased trees, the symptoms of which will probably appear much sooner than under other conditions. It is due to the belief that peach yellows can be distributed on nursery stock, that California has maintained such a strict quarantine on all peach trees from the yellows districts for so many years, and it is the object of this article to make known to our growers the present limits of such districts so that no diseased stock will gain admittance from newly diseased areas.

Control.

The control of yellows, as well as little peach and peach rosette, means the destruction of all diseased trees. The quicker this is done the better. Eastern experts remove the tree just as soon as the first symptoms appear on nursery seedlings or young trees set out in orchard form.

PEACH ROSETTE.

History.

Peach rosette has been observed from its first appearance in Georgia for about thirty-two years. It has not made the headway of peach yellows, but is very serious where it does occur.

*Bulletin 226, New Jersey Agricultural Experiment Station, page 13, 1911.

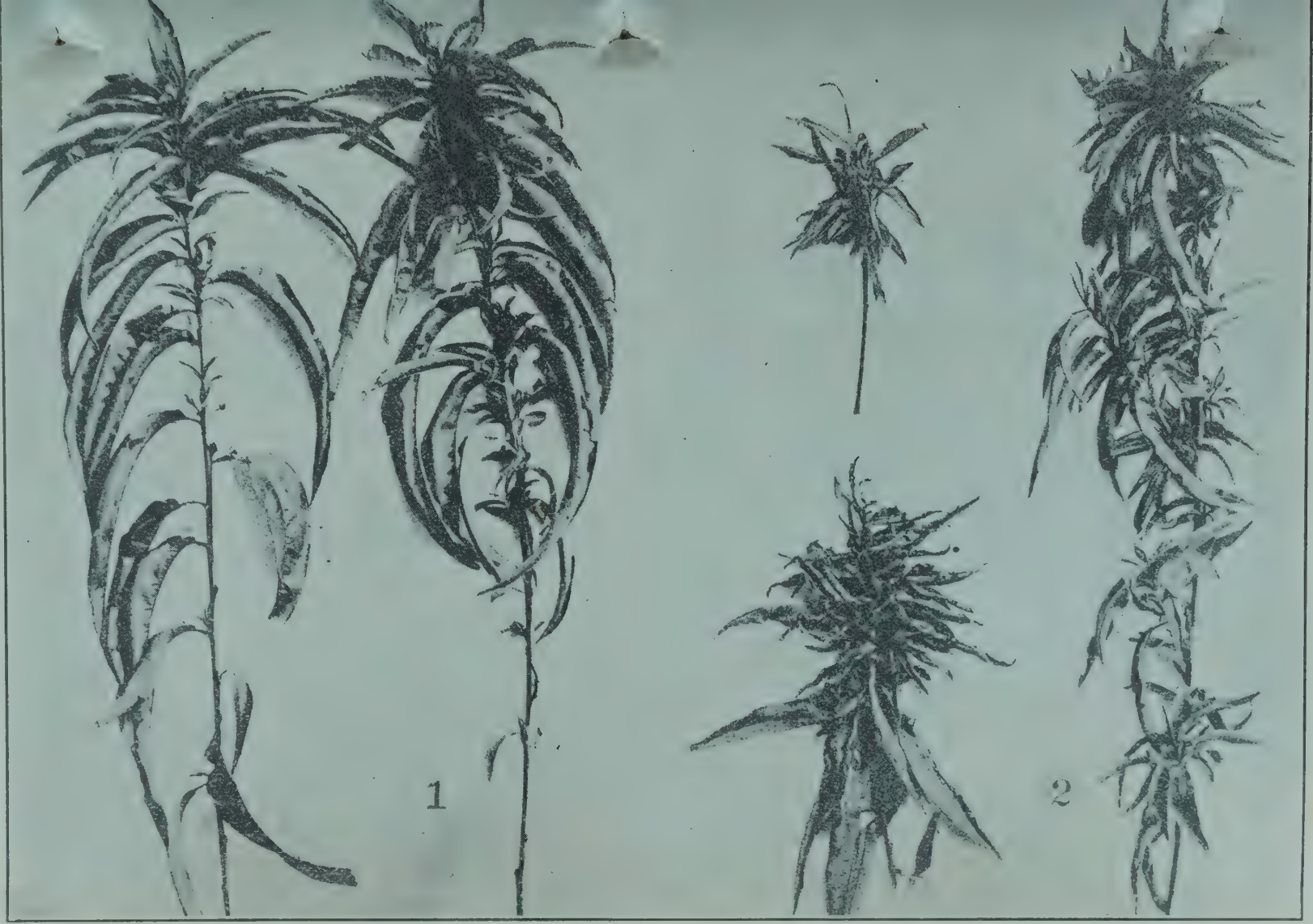

FIG. 137.—Peach rosette: 1, healthy peach twigs; 2, diseased twigs showing characteristic tufted or rosette growth. (U. S. Dept. Agrcl.)

Destructiveness.

Peach trees affected with rosette are killed in a very short time. After showing first symptoms they usually die within five months. No trees affected by the disease have been known to live longer than three years.

"Next to peach yellows, I regard it (peach rosette) as the most dangerous enemy to peach culture in the United States. In some respects it is worse than yellows, because it runs its course more speedily and is more apt to take the entire tree from the start." Erwin F. Smith, Bulletin No. 1, Division of Plant Pathology, U. S. Dept. of Agriculture, page 49, 1891.

Distribution (Fig. 138).

Though there is some confusion as to the exact distribution of peach rosette, it is a well known malady in Kansas, Missouri (in the southern Ozark Mountain region), Arkansas (northern part), Tennessee, Georgia and South Carolina (the western border). It has also been reported as occurring in northern Wisconsin, in Massachusetts, and in Florida, though there is considerable doubt as to whether it is of any importance in these localities. Commercial peach growing is certainly not practiced in northern Wisconsin.

Since making up the maps the disease has also been reported as occurring near Natchez along the Mississippi River and near Pascagoula on the Gulf in the State of Mississippi.

Plants Attacked.

Apparently all varieties of peaches, budded and seedlings, are attacked. Plums are also affected: those found to be diseased are *Prunus chicasa,* Cumberland, Wild Goose and Kelsey and Botan of the Japanese varieties. The varieties of *Prunus domestica* and the Mariana have never been found affected with rosette.

Nature and Symptoms.

Peach rosette differs from yellows by the absence of any quantity of premature fruit and by the more tufted or rosette character of the growth (Fig. 137). The disease will appear in any one portion of a tree, and though the symptoms may be slow to develop the disease spreads much more rapidly than does yellows. Symptoms are slow in developing over all parts of the tree. One side may appear perfectly healthy and the other side very much diseased. The foliage of diseased portions appears yellowish green. The outer leaves of a rosette attain considerable length and the midribs are noticeably stiffer than those of normal leaves. These leaves mature early in the summer and drop while the inner leaves of the rosette are still green.

Trees severely attacked usually produce no fruit, but where fruit is produced it shrivels up or drops off while green, or ripens prematurely.

The roots of diseased trees are honeycombed by gum-pockets, some of which are to be found on a few roots of nearly every tree. The rootlets usually die early in the stages of the disease.

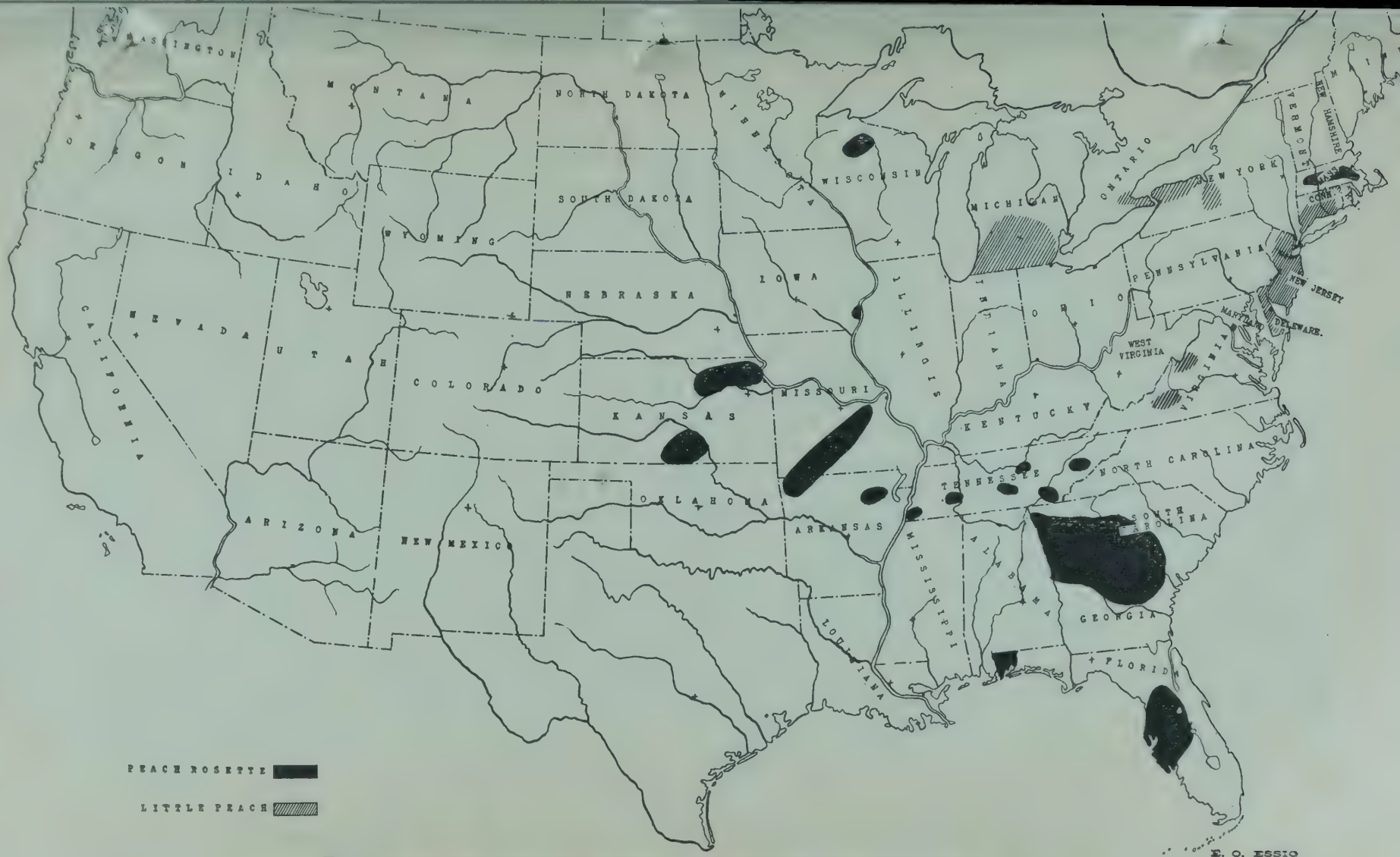

FIG. 138.—Map showing the distribution of peach rosette and little peach. (Original.)

Modes of Distribution and Control.

Rosette, like peach yellows, may be distributed from one tree to another, by grafting or budding from diseased trees to healthy trees. As little or no fruit is produced it is seldom, if ever, propagated with seedlings from diseased pits.

LITTLE PEACH.

History.

Little peach has been known only for a comparatively few years. It was probably first observed in Michigan about seventeen years ago and occurred in New York about the same time. It is thought to have been introduced with Japanese plums (Bulletin 226, New Jersey Agriculture Experiment Station, page 18, 1910).

Destructiveness.

The amount of damage caused by little peach corresponds well with that caused by yellows and rosette in all districts where it is known to occur. In fact, it is closely related to the former diseases. In some districts, however, it is causing more damage than yellows or rosette, and many orchards have been destroyed by its ravages.

Distribution (Fig. 138).

Little peach is at present found in the peach-growing sections of southern Michigan, around the southern shores of Lake Ontario in New York, in Ontario, Canada, in Connecticut, New Jersey, Delaware, and in two localities near the western border of Virginia.

Plants Attacked.

So far as I am able to ascertain little peach works on the same varieties of trees as does peach yellows and peach rosette, the principal of which are peach and plum.

Nature and Symptoms.

The most prominent symptom of little peach is the behavior of the fruit. Instead of ripening prematurely as in the case of both yellows and rosette the fruit remains small and is often a week or more later in ripening than normal, and seldom shows red spotting, so characteristic of yellows. Neither do the trees produce the wiry, sickly shoots as does yellows, nor the rosettes so common in peach rosette. The foliage varies in color from a very light green to a yellowish green.

The fruit is often highly colored, but insipid and watery. The flesh of many early clingstone varieties appears stringy.

In young trees the disease produces a noticeable upright growth from the very beginning.

Modes of Distribution.

As pits from badly affected fruits do not germinate it is not possible to raise diseased seedlings for nursery purposes. Though it is a common belief that little peach is distributed by nursery stock, yet the

extent of such distribution is still a point of doubt, but in cases of such doubt it is always well to be on the safe side.

Control.

As in the case of yellows and peach rosette the only reliable method of control is the destruction of the trees just as soon as the first symptoms appear.

CORRESPONDENCE RELATIVE TO THE DISTRIBUTION OF PEACH YELLOWS AND PEACH ROSETTE.

In order to ascertain as exactly as possible the distribution of peach yellows and peach rosette, the following letter was sent out to all of the experiment stations, and Chief of the Bureau of Plant Industry of the United States Department of Agriculture as well as to the Canada Department of Agriculture:

MY DEAR SIR: This office is very desirous of ascertaining the exact distribution of the so-called peach yellows and peach rosette. In order to obtain this information, we are asking the coöperation of all the state experiment stations to this end. I am enclosing a map of your State and am taking the liberty to request you to mark out on this map all localities where these two peach diseases are known to exist. The result of this canvass will be mailed to you later, so that you may have the information at hand.

Assuring you of our appreciation for any coöperation which you may extend in this matter, I am,

Yours very truly,

E. O. ESSIG,
Secretary of State Commission of Horticulture.

In reply the following correspondence was received:

United States Department of Agriculture.
Bureau of Plant Industry.

WASHINGTON, D. C., March 8th, 1912.

DEAR SIR: Referring to your letter in regard to distribution of peach yellows and peach rosette, I have taken this matter up with Mr. M. B. Waite, our pathologist in charge of Fruit Diseases Investigations, and he gives me the following data, which may be of some service to you in this connection:

Peach yellows occupies practically all the northeastern section of the United States where the peach is cultivated. The line runs approximately as follows, although detailed separations have not been made at all points so as to be certain. Furthermore, the yellows has been slightly advancing southward, especially in the Appalachian Mountains. North and east of this line well-defined yellows may be expected to occur; south of this line it is not known, nor is it likely to be found at present.

Beginning at the seacoast on the line between Virginia and Maryland, going southeast between Petersburg and Richmond, Virginia; next through Greensboro, North Carolina, or slightly west of that point, to the South Carolina line, possibly including a very small part of the extreme northwestern South Carolina. The line should then proceed west about on the line between Georgia and Alabama, curve northwestward so as to take in a small part of Nebraska, but this is doubtful. The line should then loop east so as to touch the south end of Lake Michigan. On this last stretch of the line from Kansas and Nebraska to Lake Michigan the yellows is determined by the boundary line of peach culture.

Peach rosette occurs immediately to the south of this district in South Carolina, Georgia and Alabama; probably also in Florida. It occurs in middle Tennessee, in southern Missouri, in northern Wisconsin, and in eastern Kansas.

Yours very truly,

(Signed) B. T. GALLOWAY,
Chief of Bureau of Plant Industry.

WASHINGTON, D. C., March 29, 1912.

DEAR SIR: Your letter of March 18, about the distribution of little-peach, is at hand. I have referred this matter to Mr. Waite, who has investigated this disease extensively, and he gives me the following facts concerning its distribution:

Little-peach is distinctly northern in its range. Attention was first called to it in the region in which it probably has done the most damage—the Michigan peach belt from practically the northern line of Oceana County southward the entire distance to the Benton Harbor district. The disease also probably occurs in northern Ohio, but has not been located there distinctly. It occurs abundantly in the Ontario fruit belt of western New York. It is not so common elsewhere but occurs to the southward in the East through southern New York, and eastern Pennsylvania rather sparingly, to districts in New Jersey in the vicinity of Philadelphia. It also has been found somewhat doubtful in Delaware. It is not known elsewhere in the United States, nor elsewhere in the world. It occurs on both peaches and Japanese plums but has not been identified on any other fruits.

Yours very respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Alabama.

AUBURN, ALA., January 10, 1912.

DEAR SIR: Your letter of December 29th, addressed to Professor Duggar, has been referred to me.

Peach rosette and yellows are diseases rarely found in this State. We have a record of three old trees in Huntsville, affected with rosette, and this discovery was made last summer. So far as I know, peach yellows has not been discovered in this State.

I am referring your letter again to Professor Lloyd, the botanist, and he may have some additional data for you.

Yours very truly,

P. F. WILLIAMS,
Horticulturist Alabama Polytechnic Institute and Experiment Station.

AUBURN, ALA., May 8, 1912.

DEAR SIR: With reference to a letter I mailed you this morning under date of the 7th, I would add that I have found a report of both Mr. J. C. C. Price and Mr. Conolly, deputy nursery inspectors, that the three trees reported as having rosette near Huntsville, were dug up and burned at the time the discovery was made. This may simplify matters. However, we will of course examine carefully the area where the trouble was found and will be very glad to report to you if we find the trouble occurring in the vicinity again this season.

Yours very truly,

P. F. WILLIAMS,
Horticulturist, Alabama State Board of Horticulture.

Arkansas.

FAYETTEVILLE, ARK., January 10, 1912.

DEAR SIR: Your letter of December 29, 1911, to the director, was referred to this department for answer. I will have to confess that our information concerning the distribution of the two diseases you mentioned is rather meager at present, as there has never been a plant disease survey made of the State as yet. Such information as we possess has come through specimens of the two diseases sent in from different localities.

Enclosed you will find two cards on which I have marked the location from which we have received specimens of the diseases. I have no doubt, however, that both diseases occur in other sections of the State to a limited extent.

I am very sorry that we can not furnish you more definite information at this time, but perhaps in the future we can be of further service to you, and would be pleased to have you write us.

Very truly yours,

H. E. STEVENS,
Adjunct, Agricultural Experiment Station.

Arizona.

TUCSON, ARIZ., January 5, 1912.

DEAR SIR: Yours of December 29 came to hand when Dr. Morrill, our entomologist, was over here and was referred to him, and he knows of no peach yellows or

peach rosette in Arizona. Our Mr. McOmie, Superintendent of Institutes, states also that in his travels over the territory he has not heard of these diseases, so I presume there is nothing to say on the subject for Arizona.

Sincerely,

E. DANA TROUT,
Secretary, University of Arizona Agricultural Experiment Station.

California.

BERKELEY, February 26, 1912.

DEAR SIR: I have never known of an authenticated instance of the eastern peach yellows and peach rosette. We have plenty of chlorosis or yellowing as you know, and in the publication by Professor Smith, of which I am sending you a copy in another envelope, you will find on page 1151 an account of what is not locally called yellows, but which is identical with the eastern disease of that name.

Very sincerely,

E. J. WICKSON,
Agricultural Experiment Station.

WHITTIER, CAL., February 17, 1912.

DEAR SIR: Reply to your letter of the 14th, would say that there is no record of peach yellows or peach rosette in California, and from my own observations, and those of others with whom I am in touch, I am very positive that these diseases do not occur in this State.

Yours truly,

RALPH E. SMITH,
Agricultural Experiment Station, Southern California Pathological Laboratory.

Colorado.

FORT COLLINS, COLO., January 3, 1912.

DEAR SIR: I have your inquiry concerning peach yellows and peach rosette in Colorado, and I am very glad indeed to be able to tell you that neither of these troubles has ever appeared in this State, and I hope they never will.

Yours very truly,

C. P. GILLETTE,
Director, Agricultural Experiment Station.

Connecticut.

NEW HAVEN, CONN., January 8, 1912.

DEAR SIR: We have no peach rosette in this State, but have some small amount of little peach. Yellows is present more or less, but during the past five years has been somewhat more prominent than usual, although the tendency now is to be less. I have marked on the enclosed maps the places where we have known the yellows to exist during the past few years.

Very truly yours,

G. P. CLINTON, S.D.,
Agricultural Experiment Station.

Delaware.

NEWARK, DELAWARE, January 5, 1912.

DEAR SIR: In reference to your letter of the 29th ultimo, will say that so far as I know peach rosette has never been reported in this State. Peach yellows and "Little Peach" are common over most of the State. The southern part of the State is practically free from the disease (yellows), although I doubt not that if a systematic search was made, isolated cases might be found even in that district.

Enclosed you will find outline map of the State, with yellows line of demarkation indicated. I am,

Very truly yours,

C. A. MCCUE,
Horticulturist, Agricultural Experiment Station.

Florida.

GAINESVILLE, January 13, 1912.

DEAR SIR: Professor Rolfs has referred your letter of December 29th to me for reply. It has not been ascertained with certainty that peach yellows or rosette occur in Florida, although there is a trouble quite closely related to it that seems

to show symptoms of both yellows and rosette on the same trees at the same time. I am marking on one of the maps the known localities for this doubtful rosette-yellows. Most of this information has been collected by my assistant, Mr. O. F. Burger.

Very truly yours,

H. S. FAWCETT,
Agricultural Experiment Station.

Idaho.

BOISE, IDAHO, January 18, 1912.

DEAR SIR: Your letter of December 29th, addressed to Dean W. L. Carlyle, of Moscow, Idaho, has been referred to this office. In reply will say that I do not know, at this time, of any peach yellows or peach rosette within the State. We have, however, received a shipment or two of nursery stock from eastern states, which were infected with these diseases, and the same were destroyed by burning, upon their arrival in this State.

I do not believe that there is either peach yellows or peach rosette to be found within this State. If there is, it will be found in the northern or more humid climate of this State.

Yours truly,

JOHN U. MCPHERSON,
State Horticultural Inspector, Agricultural Experiment Station.

Illinois.

URBANA, ILLINOIS, January 12, 1912.

DEAR SIR: Yours of the 29th of December addressed to the Director of the Agricultural Experiment Station, has been referred to me for reply. So far as I have direct knowledge of the matter peach rosette has never been found in Illinois, and peach yellows very seldom occurs; indeed the only information we have in this office of its existence comes through Professor S. A. Forbes, State Entomologist. He wrote to you, some two years ago, communicating at that time all of the knowledge that we now have.

Very truly yours,

T. J. BURRILL,
Botanist, Agricultural Experiment Station.

Indiana.

LAFAYETTE, IND., January 10, 1912.

DEAR SIR: Your letter of the 29th ultimo has been referred to the Botanical Department for attention. Regarding the distribution of peach yellows in this State I beg to submit the enclosed map which has check marks showing the localities where the records for the last seven years show it to have occurred. We have no record of the peach rosette. So far as we know it has not been reported in Indiana. It appears to be more southern in its distribution and perhaps may occur in the southern part of the State, but we have no authentic report.

Yours very truly,

FRANK D. KERN,
Agricultural Experiment Station.

Iowa.

AMES, IOWA, January 13, 1912.

MY DEAR SIR: Your inquiry of December 29th regarding peach diseases, addressed to Director Curtiss, has been referred to me for reply. I do not know of any case of peach yellows or peach rosette in this State. You are perhaps aware that Iowa is not producing peaches commercially to any considerable extent. In different locations in the south half of the State peaches are grown to a greater or less extent, but on account of the uncertainty of the crop this industry has never become established upon a permanently reliable basis. Ames may be regarded as practically on the north limit of peach culture in this State, although in some instances peaches have been fruited in Iowa farther north than this. I will forward your inquiry to our botanist, Doctor Pammel. Possibly he may know of some locality in the State where these diseases have been found.

Very truly yours,

S. A. BEACH,
Agricultural Experiment Station.

AMES, IOWA, January 17, 1912.

DEAR SIR: Your favor of December 29th to Professor Beach has been sent to me to confirm the statement made in the letter from Professor Beach.

Peach yellows does not exist in the State so far as I know. Peach rosette was once reported to me from near Muscatine, but I was never able to follow the matter up, and I am not convinced that this was the genuine peach rosette. I have, however, indicated a mark on the map.

Yours truly,

L. H. PAMMEL,
Agricultural Experiment Station.

Kansas.

MANHATTAN, KANS., January 30, 1912.

DEAR SIR: Your inquiry to Director Webster has reached my office and I have marked the little maps you enclosed and will enclose them herewith. It is my judgment at the present time that these diseases are not nearly so prevalent as some years ago. In view of the fact that we have had several very severe winters and a number of late frosts the number of peach trees in the State has been greatly reduced, and most growers have taken out every tree that lacked in vigor or hardiness, and it is my judgment that this severe thinning has reduced and in some sections practically eliminated these diseases.

Very truly,

ALBERT DICKENS,
Agricultural Experiment Station.

Kentucky.

LEXINGTON, KY., January 5, 1912.

DEAR SIR: I have your communication of December 29th addressed to Professor Scovell and asking about the diseases known as peach yellows and peach rosette. I must say that neither of these diseases has given any trouble in this State and both are practically unknown to our fruit men. I have had the inspection of Kentucky nurseries in my charge now since 1897, and have each year gone over the nurseries of the State, or had an assistant do it, giving close attention to this matter of the fungus and insect troubles of fruit trees. We have never seen a genuine case of either of the diseases mentioned, but some of our old fruit growers claim to have seen peach yellows here. It is my belief that they have mistaken something else for it. You will understand that trees sometimes when injured by borers, or when badly situated, will assume a sickly hue and might easily be thought to be suffering from yellows. The clusters of twigs and the characteristic changes in the fruit have never been observed by me here.

Yours very truly,

H. GARMAN,
Agricultural Experiment Station.

Louisiana.

BATON ROUGE, LA., January 4, 1912.

DEAR SIR: We have your letter of the 29th ultimo and beg to advise that we have never seen either peach yellows or peach rosette anywhere in this State, and I do not think that either one of these diseases has ever been introduced here. We do not grow a great many peaches in a commercial way in this State, but we have traveled all over the State from time to time, and have never seen anything of either of these diseases.

Very respectfully,

J. B. GARRETT,
Assistant Director, Agricultural Experiment Station.

Maine.

ORONO, MAINE, January 5, 1912.

DEAR SIR: Your letter of December 29th is at hand. Peaches are not grown commercially in this State.

Yours truly,

CHAS. D. WOODS,
Director, Agricultural Experiment Station.

Maryland.

COLLEGE PARK, MD., January 9, 1912.

MY DEAR SIR: I am returning herewith your maps showing distribution of peach yellows in Maryland, indicated by the blue shaded portion. There has been no peach rosette found in this State.

I also enclose a sketch of map of North Carolina and Tennessee, showing location of cases of yellows, which I observed in 1908, and rosette observed by me in Kansas in 1909.

Very truly yours,

J. B. S. NORTON,
State Pathologist, Agricultural Experiment Station.

Massachusetts.

AMHERST, MASS., January 26, 1912.

DEAR SIR: I hope you will pardon me for neglecting to answer your letter, which came some time ago, but I have been rushing my annual report to the exclusion of everything else.

Peach yellows has been in this State for many years, but perhaps not to a very alarming extent. The peach rosette I see only very rarely, but as that generally follows yellows, I think it is safe to put it down as being present. There are many peach trees which suffer from drought and one thing and another, and on which the foliage is rather light colored, and this condition is often taken for yellows; but this is not yellows at all. There is a distinct type of disease, as every pathologist knows, called yellows, and we do get it here occasionally. These trees as a rule die very quickly. I presume the disease is not as severe here as in Michigan and some other sections.

Yours very truly,

G. E. STONE,
Agricultural Experiment Station.

Michigan.

EAST LANSING, MICH., January 17, 1912.

DEAR SIR: Answering your letter of the 29th addressed to Dean Shaw, which has been handed to me, I will say that I have marked on the one map the part of the State in which peach yellows is prevalent. The other disease we are not troubled with to any considerable extent.

Very truly yours,

H. J. EUSTACE,
Agricultural Experiment Station.

Minnesota.

UNIVERSITY FARM, ST. PAUL, MINN., January 13, 1912.

DEAR SIR: In regard to your circular letter of December 29th concerning peach yellows and peach rosette, I wish to say that peaches are not grown at all in Minnesota.

Yours very truly,

E. M. FREEMAN,
Agricultural Experiment Station.

Mississippi.

AGRICULTURAL COLLEGE, MISS., April 18, 1912.

MY DEAR SIR: Your letter of some time ago addressed to the director of this station has been turned over to me for reply. Owing to the change in directors here at the station, and other changes, the letter was mislaid and has just been unearthed, as it were.

Replying to same can say that there is very little peach rosette and peach yellows reported from this State. A few places have reported the diseases mentioned, but they have never been reported as doing serious damage being mentioned only on a few trees. The places mentioned were near Natchez, along the Mississippi, and near Pascagoula on the Gulf.

Assuring you that I regret exceedingly this long delay, I am,

Very truly yours,

B. W. ANSPON,
Assistant Horticulturist.

Missouri.

MOUNTAIN GROVE, MO., January 17, 1912.

DEAR SIR: I am in receipt of your letter of December 29th in regard to peach rosette and peach yellows in this State. Peach rosette occurs occasionally throughout the Ozark section of Missouri, but has not, to my knowledge, been of any serious consequences at any particular point. Just an occasional tree, usually in some old neglected orchard or fence corner. We have no knowledge of peach yellows in this State.

Yours truly,

PAUL EVANS,
Director, Agricultural Experiment Station.

Montana.

BOZEMAN, MONT., January 19, 1912.

DEAR SIR: Your letter of December 29th, to Director Linfield inquiring about peach yellows and peach rosette, was referred to me. In reply, I will say that I have been through the peach growing sections each year for the last five years and have never seen a case of these diseases. The peach industry is very small here, however, which may explain in part their absence.

Yours very truly,

D. B. SWINGLE,
Agricultural Experiment Station.

Nebraska.

LINCOLN, NEB., January 11, 1912.

MY DEAR SIR: In reply to your letter of December 29th addressed to Dean Burnett, permit me to state that we have no record of the occurrence of either peach yellows or peach rosette in this State. I shall very much appreciate receiving when completed your publication on the distribution of these two diseases.

Yours very truly,

E. MEAD WILCOX,
Agricultural Experiment Station.

Nevada.

RENO, NEVADA, January 26, 1912.

DEAR SIR: In reply to your letter requesting information in regard to the occurrence of peach yellows and peach rosette in this State, I may say that peaches are grown to such a slight extent up to the present time that we have no occasion to deal with them in relation to the diseases which affect them. Occasionally we have a peach tree near a city lot or on a farm residence, but these do not bear fruit more than once in seven years.

In the extreme southern part of the State, however, particularly in the Moapa and Las Vegas valleys, peaches have been grown for many years, but up to the present time there have been no shipments. "Peach yellows" occurs there to a slight extent.

Very truly yours,

P. BEVERIDGE KENNEDY,
Agricultural Experiment Station.

New Hampshire.

DURHAM, N. H., January 11, 1912.

DEAR SIR: We have your inquiry of December 29th addressed to Director Kendall.

We have but a small number of peach orchards in New Hampshire and owing to the difficulties of raising peaches here, these orchards are generally well cared for. I have been here for six years and have had no report of peach rosette. We have had in that time, to my knowledge, but one report of peach yellows, and that was near Concord, New Hampshire. We had a call to investigate an orchard about twenty miles south of Concord, but after careful study decided that the trouble was not the yellows.

I shall be very glad to receive a copy of the information you obtained in regard to this disease.

Very truly yours,

CHARLES BROOKS,
Agricultural Experiment Station.

New Mexico.

AGRICULTURAL COLLEGE, N. M., January 5, 1912.

DEAR SIR: Professor Foster has referred your letter to me for reply. In regard to the peach yellows and peach rosette, I will say that as far as I am able to know now, these diseases are not prevalent in New Mexico at present. We have never had any reports of them and have never seen any on the trees.

Yours truly,

TOBIAN GARCIA,
Horticulturist, Agricultural Experiment Station.

New Jersey.

NEW BRUNSWICK, N. J., January 5, 1912.

DEAR SIR: Yours of the 29th ultimo has been referred to me for reply. It is not necessary to indicate the location of the peach diseases in New Jersey on the maps which you have enclosed, as peach yellows and little peach appear throughout the State. You understand, of course, that the amount of infestation fluctuates more or less from year to year.

We have never discovered any cases of peach rosette within the State.

Sincerely yours,

M. A. BLAKE,
Horticulturist, Agricultural Experiment Station.

New York.

GENEVA, N. Y., January 11, 1912.

DEAR SIR: Your letter of December 29th received. I am of the opinion that peach yellows is practically coextensive with the culture of peaches in this State. However, I am referring your letter to Mr. B. D. Van Buren, Albany, N. Y., who I think can give you more definite information. Mr. Van Buren has general charge of the nursery inspection in this State, and is in a position to get data on the distribution of peach yellows.

With regard to peach rosette, I will say that it is very doubtful if it occurs in the State. I have never seen an authentic case of it here. However, Mr. F. M. Rolfs, Department of Plant Pathology, Ithaca, N. Y., tells me that he has taken a specimen near Ithaca which he thinks is rosette. If you wish to know more about this I suggest that you write to Mr. Rolfs.

Very truly yours,

F. C. STEWART,
Botanist, Agricultural Experiment Station.

ALBANY, NEW YORK, January 12, 1912.

DEAR SIR: Professor Stewart of the New York Agricultural Experiment Station, Geneva, N. Y., forwarded your letter to me relative to the area in New York State affected with peach yellows and peach rosette. So far as I know, not any cases of peach rosette have ever been definitely identified in New York State. The distribution of peach yellows is coexistent with the area in which peaches are grown. Such an area I have outlined on the enclosed map.

Very truly yours,

B. D. VAN BUREN,
Assistant Chief, Bureau of Horticulture and Nursery Inspection, State Agricultural Experiment Station.

ITHACA, N. Y., January 17, 1912.

DEAR SIR: Your letter to Director Bailey has been referred to me to answer. I am referring the letter to Professor Whetzel, in order to give you the exact information as to the distribution of peach yellows and rosette. Professor Whetzel is the pathologist at our college, and will probably be able to give you more definite information than I have.

In a general way it may be said that the peach yellows will be confined to the peach-growing regions, and these regions for New York State are mainly two: the region of the Lake Ontario shore, comprising the counties of Niagara, Orleans, Monroe, and Wayne. This belt is a narrow strip of land bordering on the south shore of Lake Ontario. The greater part of the peaches grown in New York is grown in this belt.

Another peach-growing region for New York State is the district of the lower Hudson River Valley, mainly the counties of Orange, Dutchess and Columbia.

Although peaches are grown to some extent in other parts of the State, the peach-growing regions are confined to these two localities. I am asking Professor Whetzel to mark on the map the peach-growing region, so that you will receive the map from him.

If I can be of further help to you I shall be glad to do whatever I can.

Very truly yours,

C. S. WILSON,
State Agricultural Experiment Station.

ITHACA, N. Y., February 2, 1912.

DEAR SIR: Professor Wilson has referred to me your inquiry regarding the peach yellows and peach rosette in the State of New York. I have checked with a cross the localities in which the peach yellows is known to occur. If you are acquainted with the peach districts in the states you will know from this that none of them are free from this disease, though during the past few years the amount has been relatively small. So far as peach rosette is concerned we are not aware that this disease occurs in the State. Circles which you will find on the map represent the localities where "little peach" is known to occur. I may say for your information that "little peach" has shown up more for the last year than yellows. I shall be glad to furnish you more detailed information if you desire it, and shall be particularly pleased to have the results of your canvass.

Yours very truly,

DONALD REDDICK,
Professor of Plant Pathology, State Agricultural Experiment Station.

North Carolina.

WEST RALEIGH, N. C., January 10, 1912.

DEAR SIR: Your letter addressed to Dr. Kilgore of the Department of Agriculture has been referred to me for answer. I have marked the general distribution on the map marked "yellows" and will give you the data on which this is based. We have collections of peach yellows from Polk and Buncombe counties. It is also reported by the Bureau of Plant Industry from both of these counties. Our other entries read: "Mount Airy, Hendersonville, Alleghany, Ashe. Reported by Franklin Sherman, June 19, 1908."

"Reported by Mr. Sherman from very casual examination at the following places: Elkin, Surrey; Balsam, Jackson; Brevard, Transylvania; Waynesville, Haywood; Franklin, Macon; Hayesville, Clay; Acton, Buncombe; Hendersonville, Henderson."

Mr. Sherman has also made the following statement in a letter: "I can say in a general way that yellows is present in the State from the foothills of the mountains westward, although peach orchards in that section are few and the disease consequently is not seriously regarded."

As to the rosette we have no records whatever of its occurrence in the State.

Hoping that this answer to your inquiry will be satisfactory, I am,

Sincerely,

GUY WEST WILSON,
State Agricultural Experiment Station.

North Dakota.

AGRICULTURAL COLLEGE, N. D., January 4, 1912.

DEAR SIR: Replying to yours of December 29th, I beg to say that, owing to our northern latitude and severe climate, no peaches of any description are grown in North Dakota. We are out of the peach belt.

Very truly yours,

J. H. WORST,
State Agricultural Experiment Station.

Ohio.

WOOSTER, OHIO, January 6, 1912.

DEAR SIR: Your letter of December 29th is referred to me by Director Thorne. In reply I beg to state that peach yellows is known to occur in practically every portion of Ohio where peaches are grown to any extent. I have drawn a line across one of your maps indicating that a portion of the western district devoted to grain culture, etc., is not important from the yellows point of view; nor would I have you understand that the yellows occurs in every locality in the State, but that it is

found irregularly in districts according to the care followed by the orchardist to clean it out promptly.

We have no exact information concerning the presence of peach rosette in Ohio.

Herewith, under separate cover, I take pleasure in mailing you bound copy of my published Handbook on Plant Diseases.

Assuring you we are pleased to be of service, I am,

Very truly yours,

A. D. SELBY,
Botanist, State Agricultural Experiment Station.

Oklahoma.

STILLWATER, OKLA., January 5, 1912.

DEAR SIR: Your letter of the twenty-ninth ultimo, addressed to Professor James A. Wilson, director of this experiment station, has been referred to me for attention. I am returning the two clippings unmarked previously inclosed by you.

I beg to state that our data does not show the presence of peach yellows, peach rosette (?), or plum rosette.

Very truly yours,

C. E. SANBORN,
Entomologist, State Agricultural Experiment Station.

Oregon.

CORVALLIS, ORE., January 6, 1912.

DEAR SIR: Your letter of December 29th, addressed to Doctor Withycombe, director of this station, concerning peach yellows and peach rosette, has been referred to me for reply.

I would say that no authentic cases of peach yellows and peach rosette have ever been brought to my attention in this State. It is possible that they occur, but certainly not in a very serious condition or with our large volume of correspondence we would certainly have heard concerning it.

Very truly yours,

H. S. JACKSON,
State Agricultural Experiment Station.

Pennsylvania.

STATE COLLEGE, PA., January 6, 1912.

DEAR SIR: Your favor of December 29th has been referred to this office, and in reply I would say that peach yellows is distributed practically throughout this State wherever peaches are grown, although in some parts of the State it is much less severe than in others. Peach rosette, so far as I know, does not occur within the State. If you wish more detailed information than this, kindly let me know.

Yours truly,

J. P. STEWART,
Experimental Pomologist, State Agricultural Experiment Station.

Rhode Island.

KINGSTON, R. I., January 8, 1912.

DEAR SIR: Your letter of recent date to Dr. Wheeler has been referred to this office for reply.

In regard to the diseases which you mention will say that peach rosette is not known in the State and peach yellows is so generally distributed that it would not be worth while for me to attempt to mark the localities in which it occurs. It has been found in all parts of the State where peach trees have been grown.

Very truly yours,

A. E. STENE,
State Agricultural Experiment Station.

South Carolina.

CLEMSON COLLEGE, S. C., February 19, 1912.

DEAR SIR: Yours of the 16th instant addressed to the director of the experiment station has been referred to me. In answer to same, I wish to say that neither peach rosette nor peach yellows has been reported in this State. It is possible that

the rosette occurs here, but I am satisfied that it is not causing any very serious trouble, otherwise we would have had report of it. This seems to be a little far south for peach yellows.

Very truly yours,

H. W. BARRE,
Botanist, State Agricultural Experiment Station.

South Dakota.

BROOKINGS, S. D., February 16, 1912.

DEAR SIR: Your letter of February 10th to Professor Wilson has been referred to me to-day. Concerning peach rosette or yellows in South Dakota I can assure you that we do not have any of these diseases in our State, for we do not grow any peaches here at all.

Yours truly,

H. C. SEVERIN,
State Agricultural Experiment Station.

Tennessee.

KNOXVILLE, TENN., January 5, 1912.

DEAR SIR: Your letter of December 29th addressed to Professor H. A. Morgan has been referred to me.

We have not a full survey of the peach yellows and rosette occurring in Tennessee. I am checking on the inclosed maps centers where we have located the diseases.

When you have finished your investigations, I would be pleased indeed to receive a copy of the report.

Trusting that the inclosed maps will be of some value to you, I am,

Sincerely yours,

G. M. BENTLEY,
State Entomologist and Plant Pathologist, State Agricultural Experiment Station.

Texas.

COLLEGE STATION, TEXAS, January 11, 1912.

DEAR SIR: In answer to your letter of December 29th I wish to state that no reports of peach yellows or peach rosette have come to this station from any part of Texas, nor has any such disease upon the peach tree come under my own observation in this State; and I take it for granted that up to the present Texas is free from said diseases.

Yours truly,

H. NESS,
Horticulturist, State Agricultural Experiment Station.

Utah.

LOGAN, UTAH, January 10, 1912.

MY DEAR SIR: Your inquiry of recent date directed to Dr. Ball relative to peach yellows and peach rosette was referred to me. In my observations and experiments throughout the State, I have never come in contact with these two peach troubles. If they exist in Utah at all, they are of a most minor prevalence. If at any time the diseases appear, I will acquaint you with the findings and assure you I look forward to any report you may make along these lines.

Very respectfully yours,

LEON D. BATCHELOR,
Horticulturist, State Agricultural Experiment Station.

Vermont.

BURLINGTON, VT., January 9, 1912.

DEAR SIR: With respect to your inquiry of December 29th, will say that there are no peaches grown in Vermont, consequently I have no knowledge as to peach yellows and peach rosettes. However, I must qualify this statement by saying that there is one orchard owned by Mr. Dwight Miller, of Dummerston, Vermont.

Yours very truly,

WM. STUART,
Professor of Horticulture, State Agricultural Experiment Station.

Virginia.

BLACKSBURG, VA., January 5, 1912.

DEAR SIR: Your letter of the 29th ultimo addressed to Dr. S. W. Fletcher has just been referred to this office. I am sending you under separate cover copy of the seventh report of the state entomologist. On page 71 you will find a map of the State of Virginia giving distribution of the occurrence of peach yellows and little peach by counties. So far peach rosette has not been reported from this State. I hope that this map will be of some service to you in your canvass of these diseases in the different states.

Yours very truly,

W. J. PRICE,
Assistant State Entomologist, State Crop Pest Commission.

BLACKSBURG, VA., January 8, 1912.

DEAR SIR: Your inquiry concerning the distribution of peach yellows and peach rosette has been referred to me by Professor Johnson of Norfolk, Va. I enclose herewith a map drawn up two years ago, representing the distribution of the peach yellows at that date. So far as I know, peach rosette has never been found in this State.

Yours very truly,

HOWARD S. REED,
State Agricultural Experiment Station.

Washington.

PULLMAN, WASH., January 5, 1912.

DEAR SIR: Your letter of December 29th was turned over to me for reply. In looking up the records I find that peach rosette has never been reported from any section of the State, but that peach yellows, or what seemed from the description sent in to be cases of that malady, was reported in 1910 from the two districts indicated on the map in black ink. It is not common in the State, however, if we can judge by the absence of complaint about any similar trouble from our records of 1909 and also of the last year.

Very sincerely yours,

H. P. BARSS,
State Agricultural Experiment Station.

West Virginia.

MORGANTOWN, W. VA., January 11, 1912.

DEAR SIR: Your letter of December 29th, addressed to Mr. James H. Stewart, has been referred to me.

Enclosed you will find an outline map of West Virginia with marks in a large number of the counties of the State. These checks indicate the presence of the yellows and I have no doubt but that the disease occurs in practically all the other counties not marked. However, they have not been inspected. We have no record of peach rosette in this State as far as I know.

Very truly yours,

W. E. RUMSEY,
State Agricultural Experiment Station.

Wisconsin.

MADISON, WIS., January 4, 1912.

DEAR SIR: Your letter of recent date to Dean Russell has been referred to the Horticultural Department. In reply would say as peaches are not grown in Wisconsin we do not have any areas affected with peach yellows and peach rosette.

Very truly yours,

JAMES G. MOORE,
Associate Horticulturist, State Agricultural Experiment Station.

Wyoming.

LARAMIE, WYO., January 4, 1912.

DEAR SIR: Your letter of December 29th at hand. I am turning this over to Professor Aven Nelson, who is the horticulturist of the experiment station. I do not think we are troubled much with peach yellows and peach rosette, but he will inform you in regard to this.

Very sincerely yours,

HENRY G. KNIGHT,
Director State Agricultural Experiment Station.

LARAMIE, WYO., January 8, 1912.

DEAR SIR: Peaches are not grown in Wyoming, except in a few instances and then they are regarded as a curiosity. It follows, therefore, that peach yellows and peach rosette are still not within our borders.

Sincerely yours,

AVEN NELSON,
Secretary State Agricultural Experiment Station.

Canada.

TORONTO, March 28, 1912.

DEAR SIR: Your favor of the 8th instant to the honourable the Minister of Agriculture has been sent on to this branch for reply.

Of the peach diseases mentioned by you the yellows is generally distributed throughout the peach sections of this province and has been with us for a long time. Little peach has been introduced to Ontario within the past two or three years and has caused a great deal of damage in the Niagara district. Last year our inspectors condemned and cut out about 60,000 trees in this district and quite a large number will have to come out again during the present season. We have improved our inspection system, placing the field men directly in charge of one of our experts from the agricultural college, and hope within a short time to have the peach orchards practically cleared of the disease. Yearly inspection after this present season should enable us to keep the disease in check.

Peach rosette is unknown in the province. This province produces about 98 per cent of the peaches raised in Canada, the balance coming from the province of British Columbia. I believe that this latter province is free from peach disease, but would refer you to Mr. R. M. Winslow, horticulturist, Victoria, B. C., for definite information.

I am enclosing a marked map showing the distribution of the two diseases mentioned.

Yours very truly,

R. V. HODGETTS,
Director, Ontario Department of Agriculture, Fruit Branch.

California State Quarantine Law Relating to Peach Yellows and Peach Rosette.

An Act to Provide for the Protection of Horticulture and to Prevent the Introduction into this State of Insects or Diseases, etc. (Approved January 2, 1912.)

SEC. 6. No person, persons, firm or corporation shall bring or cause to be brought into the State of California any peach, nectarine, or apricot tree or cuttings, grafts, scions, buds or pits of such trees, or any trees budded or grafted upon peach stock or roots that have been in a district where the disease known as "peach yellows" or the contagious disease known as "contagious peach rosette" are known to exist, and any such attempting to land or enter shall be refused entry and shall be destroyed or returned to the point of shipment at the option of the owner, owners or agent, and at his or their expense.

THE CONTROL OF PEACH CURL LEAF.

By CHAS. B. WEEKS, Horticultural Commissioner of Tehama County, Red Bluff, Cal.

A few years ago the writer was very much discouraged by losing two crops of Elberta peaches from the fungus disease, curl leaf (*Exoascus deformans*). The first crop was lost by the complete defoliation of the trees in April, by the curl leaf, and the consequent dropping of the fruit. The trees being unprotected sunburned very badly and failed to develop any fruit buds during the summer, and the following spring found the orchard without any blossoms and the trees in very poor

condition. This was the experience of many growers in this county, and for a while the advisability of making new plantings of Elbertas was questioned.

Varieties Attacked.

The varieties most susceptible to attack are Elberta, Early Crawford, Late Crawford, Susquehanna, Hale's Early, Seedlings, Lovell and Muir, in the order named.

The Muir is the nearest to being immune of any variety, standing throughout a season without a sign of the disease when the other varieties named suffered severely, but this is an exception and not a rule, and the Muir should never be neglected on the supposition that because it will not curl some seasons it is not necessary to spray.

Appearance of Curl Leaf.

Almost every grower is familiar with the appearance of curl leaf and I will give but a short description of it. As soon as the leaves have attained a length of half an inch or so it will be noticed that the diseased ones have a lighter color than the healthy leaves and have

FIG. 139.—Work of the curl leaf on peach foliage.
(Cal. Agrcl. Exp. Sta.)

begun to bend either backward or to one side. In a short time they take on very grotesque forms not to say disgusting (Fig. 139). In three weeks or a month the leaves that are completely curled will begin to drop while those that are curled on one edge will only stand for a week longer. In the case of trees that are badly attacked all the leaves will drop (Fig. 140). Where the attack is lighter the bottom leaves drop, the disease appearing to work up the tree, or rather making its appearance on the lower limbs first.

Time of Control.

Practically absolute control can be obtained by spraying with Bordeaux mixture. There are two seasons of the year when curl leaf can be successfully controlled: in the fall between the fifteenth of November and the fifteenth of December, and in the spring before the leaves begin to show green.

Method of Control.

If the curl is to be combated in the fall a much stronger solution of Bordeaux must be used than if the spraying is to be done in the spring, 7 pounds bluestone, 7 pounds lime, to 50 gallons of water being the

FIG. 140.—Peach tree showing the effects of a bad attack of curl leaf. (Original.)

strength used for this spray, or the same used for spraying peach blight, while 4–4–50 is strong enough for the spring spraying.

If the spraying is done in the fall and the season is very favorable to the growth of the curl leaf fungus, the control will not be quite so complete as if the spraying had been done in the spring. The experience of the growers of this county indicates that the fall spraying is to be desired for the reason that the orchards are dry enough at this season of the year to carry a spray outfit without cutting the ground up, and absolute control of peach blight can be obtained at the same time.

Should it happen that both fall and spring spraying have been neglected and the new leaves show that the curl is making its appearance, much damage can be prevented by spraying with Bordeaux 2–2–50. This, however, cannot be recommended except as a last resort when cir-

cumstances have prevented the former application. Do not think from this statement that this spraying is of doubtful benefit, as in some seasons it means the difference between a full crop and none at all if it is done before the leaves have become half grown. If sprayed later than this the benefit is very much less. Peach leaves at this time are very susceptible to Bordeaux injury and care must be taken to have not more than two pounds of bluestone and at least two pounds of lime to fifty gallons of water.

From the writer's experience the commercial lime-sulphur has a marked fungicidal value when used as a spray for the peach worm just as the blossom buds are beginning to open, using it at a strength of 1 to 11 water.

If the fall spraying for blight and curl leaf is practiced and the trees sprayed with lime-sulphur in the spring it will be found that the trees are in better condition than could be obtained from following any other course.

It has been observed that trees sprayed by the rule above mentioned for several years in succession, except this season, show less curl leaf than unsprayed trees; in fact, so little as to cause no commercial loss. While this has proved the case this year, it cannot be stated as a fact that spraying every other year will control the curl leaf.

Summary.

For commercial peach orchards spray just as the blossom buds begin to open, with lime-sulphur 1 to 11. In fact, any orchard that the owner depends on for a living, will show big returns from spraying with Bordeaux between the fifteenth of November and the fifteenth of December, using the 7–7–50 strength.

If for any reason the fall spraying has been omitted and the owner wishes to spray for the peach worm and the curl leaf at the same time, the lime-sulphur and Bordeaux (4–4–50) may be combined. If no spraying has been done until after the leaves have started and show green, spray with Bordeaux 2–2–50. Never depend on a dry season being free from curl leaf.

THE LEWIS WOODPECKER—A DESTROYER OF ALMONDS.

By H. C. Bryant, Fellow in Applied Zoölogy on the Fish and Game Commission Foundation in the University of California.

This year has seen several extraordinary migrations of birds. The early spring saw the band-tailed pigeons in unusual numbers. At the present time western tanagers are unusually abundant in the southern part of the State. Lewis woodpeckers also have appeared in great numbers in some of the valleys of the northern part of the State. These unusual migrations should be of interest to every rancher, for it is at these times that depredations by birds are most apparent. It is only when the robins appear in very large numbers that we have any serious complaint of their depredations in olive orchards. It is only natural,

therefore, to expect this year a larger toll to be taken by tanagers in the fruit orchards of the south. For the same reason we might have expected almost any of the birds, whose extraordinary migrations have appeared this year, to cause some trouble.

We have an interesting case in the Lewis woodpecker (*Asyndesmus lewisi*). This bird has heretofore been considered of little economic importance as far as its depredations were concerned. The apple growers of Oregon and of the small valleys of the northern part of the

FIG. 141.—Lewis woodpecker (*Asyndesmus lewisi*). (By permission from U. S. Biol. Surv. Bull. No. 37.)

State have occasionally been bothered by the black or Lewis woodpecker during its migrations, for the birds have a healthy appetite for ripening apples. This woodpecker is a high mountain bird, however, and is seldom found in the valleys except when driven down by lack of food or extreme weather conditions. The past few months have seen this same bird turning its attention to almonds. The almond growers of the Capay Valley have apparently suffered most, and probably with good reason, for in this particular valley the birds have been especially abundant.

That the damage caused in the almonds has been real cannot be doubted after an examination of the accompanying photograph. Nor do the pecked almonds tell the full extent of the damage, for in many cases nuts were simply knocked from the tree when the birds attempted to pick into them.

Stitt and Niemann, almond growers at Guinda, speaking of Lewis woodpeckers, writes as follows: "This spring there was an unusual

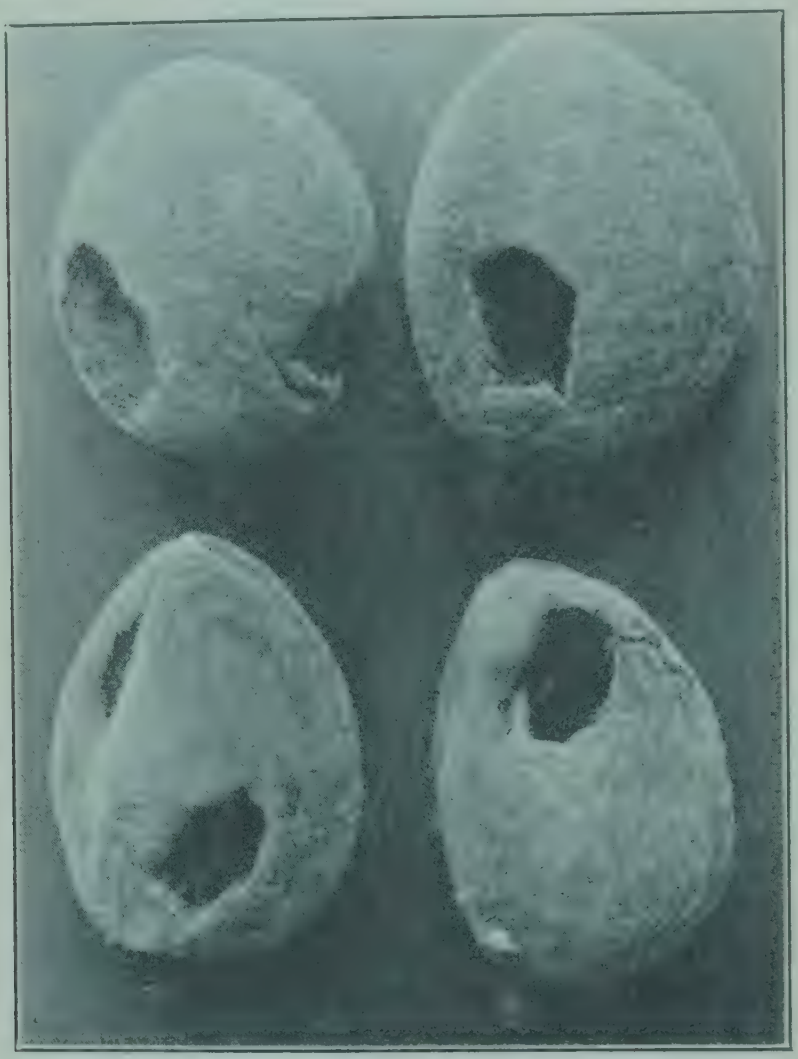

FIG. 142.—Almonds destroyed by Lewis woodpeckers. (Nuts collected on ranch of B. F. Davisson, Guinda, California. (Original.)

amount of them, and they have done serious damage to our almond crop. We should say that they have taken probably about 10 per cent of the crop." Millard McKellip, of Tancred, writes: "On my orchard I think the damage done by the Lewis woodpeckers is about 1 per cent."

Stomach examination of five Lewis woodpeckers taken at Guinda, in an almond orchard, confirmed the evidence furnished by the almonds picked up from the ground. Over 65 per cent of all the food eaten by these birds was made up of small pieces of almonds. An additional 16

per cent was of vegetable matter, but could not be definitely determined as almond meats. The animal food, amounting to 15 per cent, was made up of beetles and ants. One stomach contained five undetermined larvæ.

The California bluejay is by far the worst pest in the almond orchard. The Almond Growers' Association in the Capay Valley has been paying a bounty of five cents a head on these birds for the last two years, hoping thus to protect the crop. Mr. S. Gladney, Guinda, Cal., writes: "I have often lost one half ton of almonds from bluejays in one season, which would be worth from $125 to $150." Such destruction demands either a method of protecting the crop or the extermination of the bluejay.

The California woodpecker, the red-shafted flicker, and the crow have occasionally given trouble in almond orchards, but as a rule have not been numerous enough to cause any great loss. The great numbers of Lewis woodpeckers concentrated in a small area, however, have made a real problem, the solution of which, to say the least, is difficult. Whether protection for the crop could be obtained by systematic shooting is problematical, even if such a course could be justified. The protection of the trees with mosquito netting seems still less practical; in fact, the problem seems to sift down to the same one so apparent with the depredations of the robin in olive orchards,—a useful bird, occasionally causing damage during migration.

It has long been known that birds change their habits during migration. This change of habit was especially evident in the extraordinary migration of the Lewis woodpecker this year. This bird in its mountain home is nearly always seen either perched high up on a dead pine, eighty or a hundred feet above the ground, or flying out from such a perch, apparently catching insects like a flycatcher, or sweeping in flocks, made up of scattered individuals, high above the forest. In the Capay Valley, during April and May, the birds were seen on the ground, on fence posts, telegraph poles, in orchards, and even on buildings. The unusual numbers of the birds and the remarkable change of habit has caused the almond growers of the region not only considerable loss, but considerable anxiety.

The Lewis woodpecker is usually considered a very useful bird because of its value as an insect destroyer. Dr. C. Hart Merriam says of this bird: "Like the California woodpecker, it is a skillful flycatcher, pursuing and capturing insects in midair. But in fall and winter its principal food is acorns, of which it eats surprising quantities. At this season it is usually seen in small flocks of from 6 to 20 birds, each carrying a large acorn in its bill." The fact that the bird is not known to dig into wood after wood-boring insects makes its usefulness less apparent, as does also its habit of feeding to a large extent on mast.

As this is apparently the first time that the Lewis woodpecker has caused any extensive damage to the almond crop, and since the birds are known to only occasionally appear in numbers in the valleys, no deep concern need be felt. The extraordinary migration of the present year

can be attributed to a combination of factors, chief of which is food supply. The exceptionally dry year has probably caused a shortage of the usual food supply, and the birds have, therefore, had to seek food elsewhere. No more beautiful or more interesting bird exists in the State, and it is to be hoped that its depredations will be so occasional and so local that it may continue to be classed as a beneficial bird.

A SERIOUS WALNUT PEST.

(Ephestia elutella Hubn.)

By Frederick Maskew.

In the last issue of the Bulletin (No. 7) the writer set forth his intention to record some of the miscellaneous work of the Quarantine Division in

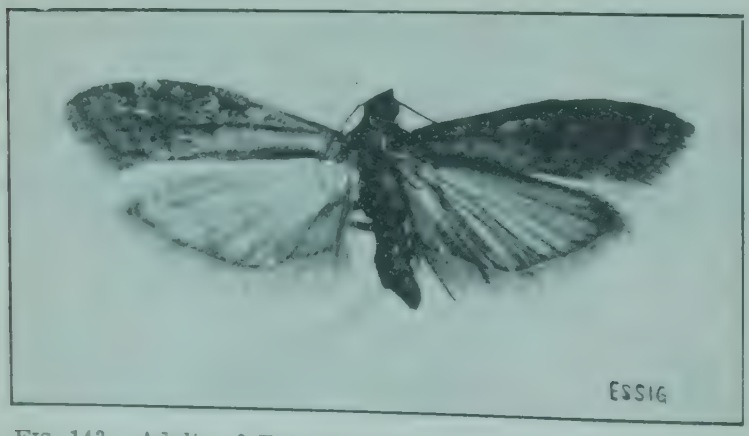

Fig. 143.—Adults of *Ephestia elutella* bred from walnuts imported from Manchuria.

an effort to show the scope and breadth of this same work, in its original intention to safeguard every different phase of horticulture in the State against additional burdens, by preventing the entrance of new and

destructive insects. In this instance the walnut industry received some benefit from the work of the division.

This insect is recorded as being cosmopolitan in distribution, but so far we have no account of its being established in California or even of having been observed here until a shipment of seventy bags of walnuts, imported from Manchuria, arrived at San Francisco on the steamship "Tenyo Maru" from Shanghai, China. To the inspector in charge it was apparent, as soon as the first sacks landed on the dock, that something was radically wrong with this material. Small white cocoons were conspicuous on the outside of the sacks, and a close inspection

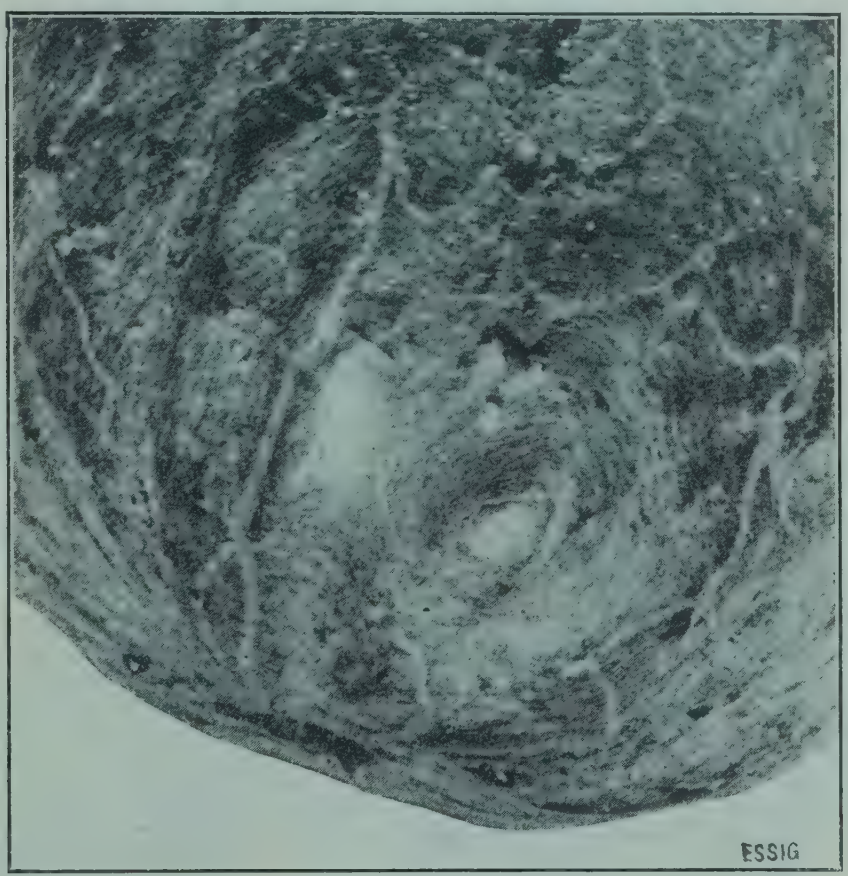

FIG. 144.—Eggs of *Ephestia elutella* on walnut. The egg-clusters are in the center of the picture.

showed the larvæ (Fig. 145) crawling on the outside of the sacks and much more abundantly on the inside and generally through the contents. Adults, also, were commonly found in this instance. Fumigation was promptly applied to the entire shipment to prevent the escape of the insects in any of the different active stages, and a still further search of the material made.

Upon the inside of the sacks were found extensive webs, white in color and of a delicate silken texture; under this protection the larvæ moved freely, having left the nuts upon which they had been feeding, and congregated under these webs in numbers. A small amount of material

was placed in a breeding jar before fumigation, and from this the following observations of the life history were made. These of a necessity are brief, and were obtained under the abnormal conditions of captivity:[1]

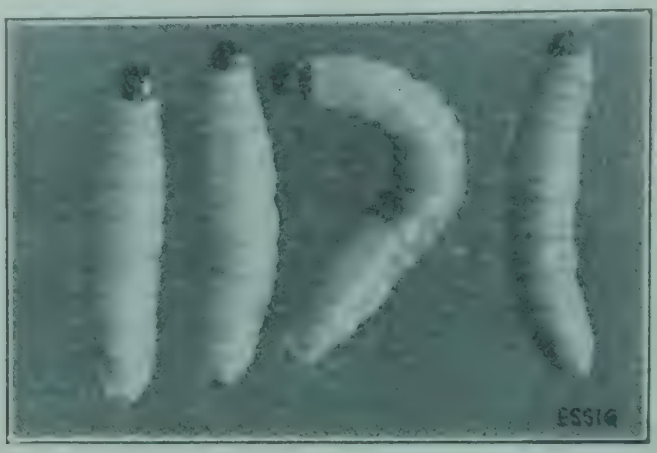

FIG. 145.—Larvæ of the walnut moth.

Eggs. (Fig. 144.)

Very minute, almost one half as large as an ordinary pinhead, oval, perfectly formed; pearly white, dull. Hardly visible to the naked eye.

Laid singly, in small clusters, or in large numbers on the outside of the shells, within the shell walls or on the kernels if they are exposed.

FIG. 146.—Pupæ of the walnut moth (*Ephestia elutella*). Left picture shows cocoons covered with frass and the chrysalids removed. Right picture shows chrysalids.

Larvæ. (Fig. 145.)

Yellowish to whitish, with head rich, shiny brown. Cervical plate light brown. Body covered with fine, colorless hairs. The young larvæ

[1]Notes by E. O. Essig, Sacramento, June, 1912.

crawl rapidly, and wriggle violently when disturbed. If possible, it falls, spinning a web for support, and hangs in midair.

The larvæ is a great web spinner, as was found by an examination of the inside of the sacks on the dock, and as is shown by the web spun entirely around the inside of the breeding jar and over the top (Fig. 149).

The larvæ are able to eat their way in through the hard shell of the nut (Fig. 147), but usually enter at the stem end where the two half-

FIG. 147.—Walnuts showing holes drilled through the shells by the larva of *Ephestia elutella*.

shells meet, and where an opening is easily made. Once inside they feed upon the kernel, the complete destruction of which is illustrated by Fig. 148.

Full-grown larvæ vary from one half to one and one half inches in length.

Pupæ. (Fig. 146.)

Pupation takes place within a very fragile cocoon. The location chosen for this period of the insect's life is not definite: the material upon arrival showed pupa on both the outside and inside of the sacks containing the walnuts. In confinement, pupa were found attached to the outside of the nut shell, and unattached within the nut. The pupæ, light brown in color, are shown at Fig. 146.

Adult. (Fig. 143.)

Female; head and thorax, rich reddish brown—darker along sides. Abdomen, silvery gray, changing to almost a rich brown.

Fore wings.

First third near body, straw to gray. The remaining two thirds of the wings reddish brown, or better, "Indian red," with dark band bordering on the lighter base, that is, between the red and the straw color. A second dark band is further back and parallel to the first, and a third

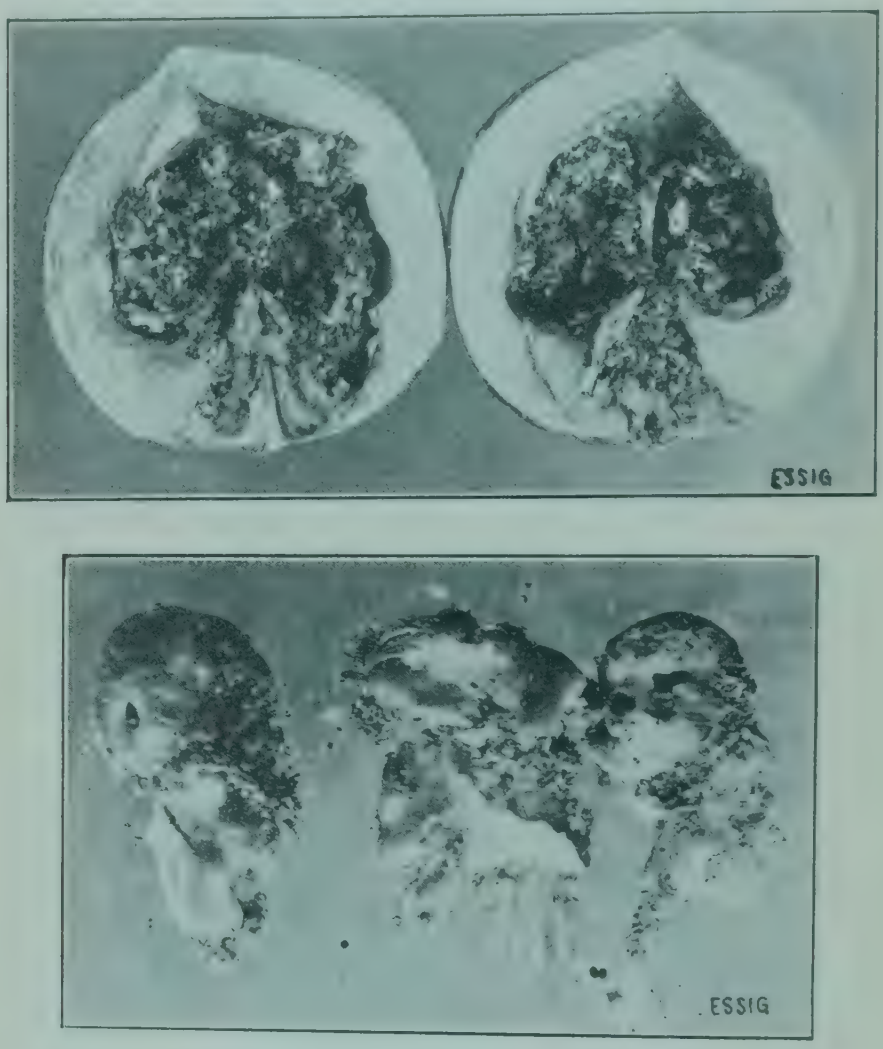

FIG. 148.—Work of the walnut moth. Top picture shows general appearance of the work inside the shell. The lower picture shows kernels removed. This is not an exaggerated example of the work.

band, or better, a spot, one third as long as the other, and a longer band (equal to the length of the first two) which extends diagonally across the tip of the wing parallel with the inner margin of the fringe. These bands are the same color as the fringe and are dark brownish or dark grayish.

Secondary wings.

Silver gray in color, with fringes the same. (Fig. 143.)

Parasites.

A hymenopterous parasite was bred from this material, but the same has not as yet been determined as to species.

In the absence of any published record of this particular pest, the prompt decision of the quarantine officer in regard to this shipment was based on the conditions as found, and also on the well-established records of the performance of other members of the same genera. The records of other species of this genera are all bad—very bad. *Ephestia kuehniella* Zeller (the flour moth) has been the source of much financial loss both to millers and dealers in grain, and when it has once taken possession of a mill or warehouse, seems to defy all attempts at eradication.

FIG. 149.—Web spun over the mouth of a six-inch specimen jar by the larvæ of the walnut moth. A similar web was spun around the entire inner surface of the jar.

Ephestia cantella Walker (the dried-currant moth), similar in many respects to the foregoing, is very destructive to stored products, being omnivorous in its feeding habits on such commodities as contain sugar or oil.

The conditions under which *Ephestia elutella* Hubn. was found at quarantine would indicate that this insect is also primarily a warehouse pest. This shipment of walnuts had every indication of having been stored for some length of time. The sacks were old, the infestation heavy, and the contents badly eaten. This, together with the evil reputation of all its family connections, resulted in its being denied admittance to California and in its prompt treatment and return to the point of shipment.

These photographs were made from specimens taken at quarantine, which were furnished by the author.

THE WORK OF THE STATE COMMISSION OF HORTICULTURE.

By A. J. Cook, Commissioner.

A paper read at the Forty-first State Fruit Growers' Convention, June 13, 1912.

Mr. President, Ladies and Gentlemen: I count it a great privilege that I can, at this time, give you a somewhat complete account of the stewardship of the State Horticultural Commission, for the first seven months of its existence under the present administration. It is a record of which we may feel justly proud, and were it not that the splendid accomplishment is largely due to my very competent assistants, and co-laborers, it would illy become me and would not savor of modesty to make this showing:

Preliminaries — a getting ready campaign — are often an important factor in any enterprise and may call for no little labor and time. Our experience was no exception to this rule. We found upon our arrival at the Capitol that the citrus trees in the beautiful Capitol Park were infested with yellow scale, one of the worst insect pests known to entomologists. We felt that such an environment was unfortunate, and so one of our first activities was a thorough cleaning up of these trees. This work was under the special charge of Chief Deputy George E. Merrill. I am pleased to report that Messrs. George G. Radcliffe and W. Vortriede, who have charge of the park and its care, gave hearty aid and coöperation in this work, and already the treated trees are showing by their renewed thrift and vigor that they appreciate this attention and relief.

The proper filing of letters, reports, books, bulletins, etc., is an indispensable aid in the conduct of such an office as that of the State Horticultural Commission. Order and system in this direction save valuable time and are an absolute requisite to the best work. One of our first duties had to do with the installing of such a system. It was no light task, requiring months of severe labor, and its completion according to the best of modern methods will add greatly to the efficiency of the work of the Commission. To the Secretary belongs almost entirely the credit of this signal improvement in the office.

In an office of this kind, we must have as complete a library in entomology and mycology as it is possible to secure; the law creating the Commission recognizes this and especially directs that such a library be acquired. Exceedingly desirable are reports and bulletins that treat of these sciences in their economic relation. We must have state reports, Farmers' Bulletins, the bulletins of the Experiment Stations, and the divisions of Plant Industry and Entomology of the United States Department of Agriculture. These, in anything like completeness, were wanting and attention was at once given to the building up of our library in these directions, than which no work could be more important. Here again the secretary has already done us an excellent service.

Another indispensable adjunct to such work as is ours to do is a good collection of insects and fungi, for reference and to aid in quick identification. There was no such collection at hand. Work was commenced

immediately to build up such a collection. The secretary of the Commission, who was the possessor of a valuable collection, at once donated it entire to the State Commission. This was a nucleus of thousands of accurately named insects, mostly of economic species, and largely from California. Prof. C. F. Baker, an indefatigable collector, has given us many thousand species and promised us as many more, so that soon we may hope, with our own efforts in this line, to have a very valuable and helpful collection of economic species that, in some ways, will rival any in the West.

When we came into the office, we found the reports of the two fruit growers' conventions, previously held, one at Stockton, December 6-9, 1910 (a year before), and the other at San Bernardino, March 7-9, 1911, yet unmailed, the latter not even ready to be mailed. The work of mailing all of these, the reading of proof for the San Bernardino report, and the entire make-up and mailing of the fortieth convention report held at Santa Rosa, December 19-22, 1911, was no slight task, as all were mailed before April 22, 1912. We were much gratified at the prompt completion of our own reports, as of course such reports are much more valuable when fresh. We are pleased to commend the State Printer, without whose efficient coöperation such promptness would be quite impossible.

We used the mailing list found in the office. This was found quite undesirable, as, when used to mail out the Stockton reports, over one hundred books were returned uncalled for. We at once asked aid of our county commissioners and have arranged an entirely new list, which is proving very satisfactory. In using this list to mail out No. 1 of our Monthly Bulletin, and the San Bernardino reports, we asked all who wished to remain on our mailing list to write us to this effect, and so we believe that now we have a bona fide list of those who really wish these valuable publications and will make excellent use of them. Many write us that they value the reports and bulletins very highly, and wish to preserve the monthly bulletins. We hope and believe that many will bind the bulletins, as these possess real intrinsic value, which will appreciate rapidly as the years go by. It is gratifying to watch their rapidly increasing circulation, which is fast reaching the 3,000 mark, and the increase is going on by leaps and bounds, each copy being sent in response to a voluntary request on the part of the recipient.

Most of you know of the terrors of the "white flies" (*Aleyrodes*). You know how they stole into four sections of our State, conveyed probably by the United States mail and express companies.

You know what a colossal burden it would impose on our orchardists, should it gain a general lodgment in our State. Under the wise and efficient action of Commissioners Elwood Cooper and J. W. Jeffrey, it was apparently exterminated in two of the infested districts, under the immediate direction of Messrs. Carnes and Maskew, now employed in the service of the Commission. It has been said over and over again that to exterminate an insect pest was impossible. The experience, in this case, gives the lie to this assertion.

An immediate investigation was made at the very dawn of this administration last November, and no trace of this white fly was found at Bakersfield or Oroville, so far as could be discovered by the most painstaking investigation. Yet it was found at Marysville in fifteen different places. Chief Deputy Merrill was delegated to proceed at once to control and even to extirpate this destructive pest in that city. A combination of all the methods that gave success before was employed—defoliation, distillate spray and fumigation. It gives me pleasure to state that the county commissioner and the people of Marysville heartily coöperated with us in this important work. I feel sure that we shall have your thorough approval and support in our determination that this arch-enemy shall be wholly eradicated from the citrus groves of California. The pest has since been found in Sacramento and all infested trees burned.

We are pleased to recognize the aid and coöperation of our State University. Our program, at this time, is a manifest of their readiness to offer valuable assistance. Our Monthly Bulletin has been repeatedly enriched by contributions from the professors of that institution. Prof. Ralph E. Smith, of the Whittier Experiment Station, has extended unusual courtesy, in granting us room and equipment for the cultural work of our mycologist. We can assure you that we shall reciprocate in every possible way, and that there will be the fullest coöperation between us and them. Their splendid research work in entomology and mycology will make our practical work in the field more virile and helpful.

Our program of this meeting is also indicative of the willingness of the United States Department of Agriculture to offer every possible assistance to us in our effort to make our horticulture more progressive. And why should this not be true? We are all working in the same great field, striving for the betterment of our agricultural knowledge and practice. If we all pull together, as we must and will, what is to hinder our reaching well up toward the highest and the best.

You who have read our Monthly Bulletin know of the great work of collecting and distributing the common American ladybird beetle (*Hippodamia convergens*). Such collection and distribution was first made several years ago. Since then Mr. E. K. Carnes, Superintendent of the State Insectary, has carried on this work, collecting and distributing these beetles by the millions. If this beetle proves to be as helpful as some think, and we all hope, then this work can be made of stupendous importance.

What we believe a very wise action was the formation of a Cabinet at the very start of our administration. All important matters are referred to this body for consideration. "In a multitude of counsellors there is safety." I am happy to state that so far every act has been unanimously approved by the Cabinet, which consists of the five chief assistants of the Commission. This makes mistakes far less likely and also explains why the action taken in the important quarantine cases, of

which you are already informed, was, we think, the best that could have been adopted.

In respect to the potato eelworm, a very serious pest, we now know that it is in four of the counties of California: Nevada, Inyo, El Dorado, and Los Angeles, and doubtless others. Can we do more, then, than to educate our people as to the best means to keep it out, if it is absent in any county or locality, and to eradicate it if it has already gained a foothold?

More than one of our nurserymen sent out stone-fruit trees infested with the peach borer. It is reported on good authority that one county in our State spends annually over $100,000 to control this moth. Trees were sent into the counties which we believe were free of this pest. We realize that in large nurseries it requires extreme vigilance to make certain that all trees shipped are pest free, but the nurserymen *must be sure*. The future welfare of our State imperatively demands this. It must be insisted upon that clean stock only shall be shipped. This may require more and better inspection. After we had declared a quarantine against certain counties, we were so fully assured of this more thorough inspection that we felt it safe and wise to revoke the order in less than a week. Results have justified this quarantine action. We believe now that its declaration and short life were alike just, wise, and right.

You have doubtless all of you read of the fearful havoc in the alfalfa fields of Utah, of a pest new to our country, the alfalfa weevil (*Phytonomus posticus*). You are aware that it is an alarming menace to our State, and that we can hardly hope, by the strictest quarantine possible, to keep it from our alfalfa fields, as it is quick to take passage even in Pullman cars. We have done our utmost to inform the alfalfa growers of the life history, destructiveness and pushing tendencies of this alfalfa weevil. We have written and distributed many thousands of copies of a bulletin giving the life history and habits of this threatening foe. We thus hope to educate our alfalfa growers so that if this beetle comes to our State it will be discovered at once and be totally destroyed before it becomes widely distributed. In case of general distribution, extermination would be almost impossible, certainly very difficult and expensive.

We have all read accounts of the most terrible and alarming pest so close to our shore, the Mediterranean fly (*Ceratitis capitata*). You know that once generally introduced into our orchards (and here almost every kind of orchard is in danger) and our four hundred millions dollars' worth of orchard property would be almost totally destroyed. This alarming menace has led us to increase and strengthen our quarantine service until we have certainly the best in the world. A special session of the legislature was called for the one and only purpose of protecting us against this arch enemy of the pomologist. We are sending $8,500 to Hawaii to aid in this colossal fight. An expert entomologist has been sent to the islands to aid in this herculean contest. We shall keep constant watch by a vigilant patrol of our entire region, lest some flies may have gained access before the quarantine was established.

Ladies and Gentlemen, we *must* and *will* spare no effort to keep this arch-enemy from our groves and gardens. Rest assured that we shall fight this foe to the death.

As most of you know, we have endeavored to secure prompt and accurate reports of the promise of our fruit crops each month. This work originated with and is under the immediate charge of our Chief Deputy, Mr. Geo. E. Merrill. He is very ably assisted by our county horticultural commissioners, to whom I wish to express gratitude for their prompt and painstaking effort to aid us in this investigation. This work is certainly appreciated and will have substantial value. We shall endeavor to make it still more correct and reliable as the months go by. We hope, and expect, to couple with this monthly crop report accurate statistics of bearing, non-bearing fruit trees and new plantings of all trees of commercial importance in our State. We also hope to give each year the cash receipts of all our leading fruits. Such data would be of immense value and, working with the county commissioners, we have the equipment that could do this cheaply and efficiently.

All well informed horticulturalists know what a burden is laid upon us by the attack of fungous pests. They stand hardly second to the insect destroyers. They are far more inconspicuous and so are more difficult to combat than our insect foes. We are in alarming need of aid against these ubiquitous and appalling enemies. In my assuming the duties of the office of State Horticultural Commissioner, I felt certain that one of the most important needs of the fruit growers was more expert knowledge, with practical work in the field, of these injurious fungi. I cast about for a man competent to handle this problem, and was very fortunate in securing the services of one of the best students of economic mycology in the world. He will do us untold good, and much of value from this meeting will be due to his able addresses. His energy for hard work is exceptional and we are to be congratulated that he is with us and one of us.

Work to insure inspection at the points of Nogales and El Paso has been pushed with all possible energy. This is greatly needed to protect us from the importation of the Mexican orange maggot (*Anastrepha ludens*), which is only second as a pest to the Mediterranean fly, in that it works on only three of our valued fruits instead of a score or more. We already have assurances of partial success and I have reason to hope that it will soon be complete. I have great faith that what ought to be will soon be. Through our deputy at Honolulu we are able to guard in part other Pacific coast ports than those of our own State. I am happy to inform you that we have enlisted the interest and action of other Pacific coast states and of British Columbia, and so feel that we are in less danger of an invasion of the Mediterranean fruit fly and the melon fly (*Dacus cucurbitæ*) via other than our own ports, through the interest and action of horticulturists of other states.

An effort was also made to secure inspection of plants sent by mail. It is believed that we received the white fly through the sending of plants by mail. We have been successful in procuring from the Post-

master General an order that plants can not be mailed without a certificate of inspection from either state or national authorities. If we can now secure an order for inspection of mail at the office of delivery, we shall have gained all that is possible in this direction.

Another improvement in our service is that of our Monthly Bulletin. We believe that through this we can keep in closer touch with our county commissioners, can keep them and also our fruit growers constantly informed of the latest and best discoveries in insect and fungoid control, and can make the Commission much more virile and its educatory influence much more wide and powerful. We have been greatly pleased with the rapid growth of its mailing list and the hearty words of praise and approval from our State, the country, and the world. It will aid us greatly, as we can secure through exchange the valuable journals, reports of societies and bulletins treating of economic entomology and mycology throughout the world. Our library is already enriched through this source.

Another new feature of our work consists in making a collection of economic species of insects and fungi, especially of our State, correctly named, and sending it to each county commission. We have already sent out five such collections, and shall complete the work as time and material will permit. The county commissioners can aid us greatly (several have already done so) by sending us specimens of any pests that may come to their notice. These should be sent in such a way as not to be crushed in transit. If put in a strong box they will resist pressure and will come safely through the mail.

We are always glad to receive letters from county commissioners, inspectors, and orchardists, which will receive prompt attention. Any word regarding new, destructive or unfamiliar insects will be especially welcome. Any important facts for the monthly bulletin will make it more valuable and will serve us and our readers.

I take pleasure in assuring you that our corps of workers consists of a harmonious, wideawake folk, ready to work to the limit. They appreciate the importance of their work, are alive to its possibilities, and will spare no thought or effort to make it in the highest degree helpful to all engaged in horticultural pursuits. We shall always welcome kindly criticism and suggestion, and assure you that we shall never be more happy than when we are doing something to contribute to the welfare and progress of our beloved State.

JUNE CROP REPORT.

By G. E. Merrill.

Almonds. The almond situation in the State has not changed materially since our last report. The crop is considerably in excess of last year's.

Apples. The apple crop of California promises to be about the same as that of last year. The prospects in Santa Cruz and Monterey counties are still good, except that a considerable drop of Bellefleurs has

been reported. The Sonoma County Gravenstein prospects are ten per cent better than they were last year at this time. Other apple-growing sections report prospects from eighty-five to one hundred and ten per cent of last year's crop.

The June report of the United States Government indicates that this year's apple crop throughout the country, with the exception of the north central division of states will be better than last year's, or the average for ten years. Reports from fourteen of the principal apple-growing states, including two from the north central division, give an average of a seventy-eight per cent crop, compared with seventy per cent last year, and a ten years' average of seventy per cent. In this connection, it is interesting to note that the census bureau reports the number of bearing apple trees in the United States for 1910 at 151,000,000 as compared with 201,000,000 in 1900.

Apricots. Somewhat conflicting reports as to the apricot situation have been received. San Joaquin County estimates indicate a crop not much more than half of last year's, and in Orange County, an important cot-growing district, there is but forty per cent of last year's crop. On the other hand, Santa Clara County, the largest cot-producing county in the State, reports a full crop this year. Some reports have been noted that the fruit will be of small size, due to lack of moisture, but the recent rains, however, have increased the size of the fruit in some districts. Alameda County reports indicate a crop ten per cent better than last year's, and those from Kings county promise fifty per cent more. The earliest fruit has been picked and marketed, and the general picking season is now well under way.

Estimates of the total output of dried apricots of this State vary from 16,000 to 23,000 tons, but it is doubtful if a total of 18,000 tons is exceeded.

Grapes. Wine grapes will be ten per cent short in Tulare, twenty per cent in Riverside and sixty per cent in Stanislaus counties. Table grapes will be twenty-five per cent short in Tulare and Fresno, twenty per cent in Riverside, forty per cent in Shasta and fifty per cent in Stanislaus. Much of this shortage is due to late frosts. Thompson's seedless will be twenty-five per cent short in Sutter County, but generally speaking there will be a fair crop of raisin grapes. In the grape-growing districts not named, this year's crop promises to equal or to exceed last year's.

Lemons. Owing to frost last winter, the lemon crop will be light. Riverside reports fifty per cent of last year's crop. Santa Barbara eighty per cent, Los Angeles seventy-five per cent, and Orange one hundred and ten per cent, the increase due largely to new orchards coming into bearing.

Oranges. A heavy drop of navel oranges early in June has been reported from the most important navel districts. Just how severe this drop is or what causes it is not yet plain. Valencias, where not injured by last winter's freeze, promise well.

Peaches. Kings, Tehama, Placer, Stanislaus, Sutter, Madera, Fresno, Butte and Los Angeles counties, all containing good peach-growing districts, report a crop equal to or in excess of last year's. Orange County reports thirty per cent, Merced eighty per cent, Napa seventy-five per cent, Shasta eighty-five per cent, San Joaquin eighty-five per cent, Tulare eighty per. cent, Sacramento ninety-five per cent, as compared with last year.

The eastern peach crop will be better this year than for some years previous. The Georgia crop looks especially good. The conditions in seventeen of the principal peach-growing states average sixty-four per cent this year as compared with fifty-two per cent last year and a ten-year average of forty-nine.

Pears. Sonoma, Sutter, and Contra Costa counties are the only pear-growing districts that now report a crop equal to that of last year. All the other pear-growing counties report prospects considerably less than those of last year. Reports of large crops in the East and other sections of the United States appear to be without foundation, as the Government reports from the principal pear-growing states give an average condition of sixty-eight per cent as compared with sixty-five per cent for last year. No report is made for a ten-year average.

Prunes. Generally speaking, the prune outlook is as good as it was last month. Kings, Madera, Fresno, Merced, Yolo, Tehama, Napa, and Shasta counties reports indicate crops as heavy or heavier than those of last year. But these counties are not dominant factors in prune production. Santa Clara County reports prospects equal to sixty-five per cent of last year's crop. The estimate of Sacramento and Contra Costa counties is placed at seventy-five per cent. Altogether this year's crop of prunes will probably fall considerably under that of last year.

GENERAL NOTES.

PROCEEDINGS OF THE SANTA BARBARA CONVENTION.

It has been decided to publish the proceedings of the forty-first California State Fruit Growers' Convention, held under the auspices of the State Commission of Horticulture, June 12th to 14th, 1912, in "The Monthly Bulletin." The reasons for this are as follows:

(1) It will enable quick publication. In the past it has required from nine to thirteen months to get out the proceedings, the single exception being the report of the Santa Rosa Convention, which was placed into the hands of the growers in less than six months.

(2) Save financially. The cost of mailing the proceedings alone would amount to over $250.00. Envelopes would cost $75.00, and extra binding $100.00. "The Monthly Bulletin" is mailed as second class matter, and as such the proceedings could be mailed for not over $20.00, while the additional cost for binding will be very small and extra envelopes not needed. At the very least it will save the Commission $300.00. The call for "The Monthly Bulletin" is so great that every means must be taken to furnish it to all.

The entire proceedings will appear in the August number, which will be wholly a convention number.

As far as possible illustrations will be worked into the various articles so as to make them more valuable.

E. O. Essig.

CONSERVATION OF BIRD LIFE AND ITS IMPORTANCE.

We are living in an age when the question of conservation is one of vital importance, and concerning this question Gifford Pinchot has said: "Our greatest problem in connection with the conservation of our natural resources is the preservation of the wild bird life of our country."

In order to realize how essential is conservation along this line, let us consider how it affects our daily lives, and the interests thus involved. Here we have a question of national importance, for the birds are one of the country's most valuable economic assets, because of the close relation which they bear to all forms of agriculture.

As the foundation of the wealth of this country is in its agriculture, so the national prosperity must depend largely on the success of this industry. This has been proven again and again, for invariably with the failure of crops comes the cry of "hard times." So we can readily see that this question affects not merely the farmer, but the banker, manufacturer, and tradesman as well; in fact, it matters not what our daily work may be, we are all primarily dependent upon the success of agriculture.

President Taft, in an address on "Conservation of Soil," states that, in 1911, there were 873,729,000 acres of farm land in the United States. Every acre of this land has its host of insect, weed and rodent foes.

which cause a yearly loss to the agricultural interest of our country of over a billion and a half dollars. Dr. T. S. Palmer, of the U. S. Biological Survey, has said: "Among the most potent agents in checking such losses are insectivorous and seed-eating birds, and the importance of their preservation, while difficult to measure in dollars and cents, is self-evident."

With the introduction of new crops has also come the introduction of new pests, examples of which are the Hessian fly, San Jose scale, and codling moth. These usually go unnoticed until they become too numerous to be exterminated. Once established, however, they are here to stay, and add their toll to the immense loss already levied on the farmer and fruit grower by native insects.

While much time and money are being spent in trying to find artificial methods of destroying these pests, we too often overlook one of nature's means of controlling them—the birds. While it may be an easy matter to destroy the birds on a farm, it is not so easy to control the insect, weed, and rodent foes which are sure to follow such destruction, for it is a well established fact that the destruction of the useful bird life of this country has been followed by a marked increase in those pests which devastate the crops, and by subsequent loss to the farmer and fruit grower. On the other hand, the protection of the useful bird population on the farm or in the orchard is sure to bring abundant reward, in the form of increased profits on the crop return.

California Fish and Game Commission.

ALFALFA WEEVIL NOT IN HUMBOLDT COUNTY.

Reports and rumors have gone abroad that the alfalfa weevil has been located at the Hoopa Indian Reservation, Humboldt County, California. There is no foundation for these reports, other than that some fields of alfalfa were destroyed there. Paul R. Jones, of the Bureau of Entomology, U. S. Department of Agriculture, and Geo. Weatherby, Horticultural Commissioner of Humboldt County, made a special trip to the reservation, and report that the alfalfa weevil is not present there, but that the damage to alfalfa has been caused by other insects. Not long ago it was rumored that the weevil was present in southern California and, fortunately, was found to be untrue. That the growers are on the lookout for this pest is well evidenced, and it is to be hoped that all supposed cases will be promptly repotred to the State Commissioner.

E. O. Essig.

A GREAT LOSS.

The resignation of Prof. C. F. Baker, as head of the department of biology of Pomona College, to take a similar position in the Philippine Islands at a salary of nearly three times the amount paid him at Pomona, is a grievous loss to the students of Pomona, to Pomona College and to the State. Professor Baker, while yet a student in college, made a

phenomenal record. Upon graduation he had a collection of plants and insects, many of them accurately named, which would eclipse that of many a veteran in the science of biology. As a teacher in the St. Louis (Missouri) High School, Colorado Agricultural College, Alabama Polytechnic Institute, and at Pomona College, he inspired a large group of the brightest students to a pitch of endeavor and accomplishment which is rarely equaled. As an investigator, he showed rare ability. His work in Cuba and in Para, Brazil, was so highly appreciated that he had repeatedly offers of $5,000 a year to return to the position he had so successfully filled. As a collector, to quote in substance Dr. David Starr Jordan, he took rank with the first. To show that he was indefatigable, we have only to state that he donated two large collections, numbering thousands of specimens each, one to Pomona College, the other to the National Museum of Washington. The one at Pomona numbered above one hundred thousand specimens of plants, and nearly as many specimens of insects.

Professor Baker gave special attention to the entire orders, Hemiptera, Hymenoptera, Mallophaga, and Siphonaptera. It was said of Agassiz that he had a wondrous knowledge of the entire animal kingdom. With equal truth this could be said of Professor Baker, and his acquaintance in the plant world is hardly less remarkable.

The Pomona College Journals of Entomology and Botany owe their existence and excellence alike to Professor Baker. How he could perform this admirable service and not neglect his other most arduous duties, passes understanding. These journals won attention and praise from nearly every country of the world.

The Laguna Beach Biological Laboratory work in the summer of 1911, and the published volume of the results, is surely a unique example of what a master can accomplish. All of the workers were either those just graduated from college, or still undergraduates, and yet, the excellence and high character of this original research work is receiving commendation from many of the first scientists of the country.

A genius, without the will to work, is still impotent in the realm of achievement. Professor Baker's greatest peculiarity was his indefatigable and persistent habit of hard work. Early and late — very late — he would be found at the laboratory, turning off work in a way that was contagious, so that even the slothful pupil brought under the spell of his untiring application, often developed into a hard student. This is why his inspiring companionship wrought so powerfully and well, and why his going brings the deepest regret to all who knew of his inestimable service and influence.

A. J. Cook.

NOTES FROM THE COUNTY COMMISSIONERS.

By G. E. Merrill.

Alameda. Commissioner Seulberger writes us that considerable numbers of vines from his district are dying from some obscure cause.

Los Angeles. William Wood, formerly deputy commissioner under Mr. Meserve, has recently been appointed county horticultural commissioner. Mr. Wood has named B. R. Jones as his deputy.

Madera. Commissioner Marchbank reports that the leaf chafer (*Hoplia dispar*) is doing considerable damage to Madera County vineyards.

Monterey. Commissioner Hickman has recently assumed the post of editor of the Tricounty Agricultural News. We are assured that the duties of his new work will not interfere with his work as county horticultural commissioner.

Sacramento. Commissioner Bloomer has been engaged in the white fly eradication campaign in coöperation with the State Commission. The most badly infested trees, ten in number, were cut back and the brush fumigated. All other trees in the infested block were also fumigated.

San Benito. A large amount of orchard planting has taken place in San Benito County during the past few years. The bulk of the planting consists of prunes and apricots.

Santa Barbara. As there is no bee inspector in his county, Commissioner Beers has been called upon to inspect incoming bees for foul brood.

Santa Clara. Commissioner Morris reports that aphids and Diabrotica have caused extensive damage to horse beans in his county. The loss was caused not so much by the direct work of the insects as by the few days of hot weather about the first of June. Ordinarily this hot weather would have done no damage, but the vines had all been so weakened by the attacks of the insects that they quickly went down under the heat. They were also attacked by a mildew.

Shasta. The pear blight is reported by Commissioner Lamiman to be very bad in Shasta County this year.

Tehama. An outbreak of the imported grape root worm (*Adoxus vitis*) on the famous Vina ranch has been reported by Commissioner Weeks.

Ventura. A general spraying campaign against the mealy bug is being prosecuted by Commissioner Vaile. He is making use of the crude carbolic acid emulsion. He is also attempting to eradicate the purple scale in scattered infestations.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF MAY, 1912.

By FREDERICK MASKEW.

SAN FRANCISCO STATION.

Horticultural imports.		Parcels
From Honolulu direct	8 ships	
Passed as free from pests		17,427
Fumigated before releasing		272
Destroyed		2
Returned		0
Contraband in ship stores or passengers' baggage		10
Total		17,711
From New Zealand, Australia and South Sea Islands	1 ship	
Passed as free from pests		3,090
Fumigated before releasing		0
Destroyed		3
Returned		0
Contraband in ship stores or passengers' baggage		48
Total		3,141
From China, Japan and Orient	6 ships	
Passed as free from pests		1,776
Fumigated before releasing		9
Destroyed		2
Returned		0
Contraband in ship stores or passengers' baggage		32
Total		1,819
From South and Central American, Mexican and Pacific coast ports	29 ships	
Passed as free from pests		6,808
Fumigated before releasing		0
Destroyed		8
Returned		0
Contraband in ship stores or passengers' baggage		41
Total		6,857
U. S. transport from Philippines and Hawaiian Islands	1 ship	
Passed as free from pests		1
Fumigated before releasing		0
Destroyed		0
Returned		0
Contraband in ship stores or passengers' baggage		0
Total		1
By railroads from all points—		
Passed as free from pests		31,467
Fumigated before releasing		0
Destroyed		1
Returned		0
Total		31,468
Parcels post from all points—		
Passed as free from pests		25
Fumigated before releasing		0
Destroyed		0
Returned		0
Total		25

TOTAL FOR THE MONTH OF MAY, 1912.

Ships	36
Passed	60,594
Fumigated	281
Destroyed	16
Returned	0
Contraband destroyed	131
Total parcels of horticultural products for month	61,022

PESTS INTERCEPTED.

From Hawaiian Islands—

Trypetidæ (larvæ) in string beans, eggplant, bell peppers, tomatoes and mangoes.
Dacus cucurbitæ (larvae) in cucumbers.
Aspidiotus sps. *Saissetia nigra*, *Howardi biclavis*, *Lepidosaphes* sps. and *Parlatoria pergandii* on cuttings of crotons, hibiscus, etc.

From Japan—

Idiopterus nephrelepidis on ferns.
Pseudaonidia pæonia, *Tingitid* sps. and *Aphis* sps. on azaleas.
Parlatoria pergandii and *Parlatoria ziziphus* on orange tree.

From Manila—

Lepidosaphes cocculi, *Hemichionaspis* sps. *Parlatoria pergandii* and *Fiorinia* sps. on orchids. *Aspidiotus spinosus*, Carpenter bees and white ants on native sticks used as packing for orchids.

From Mexico—

Aspidiotus cyanophylli on orchid.
Fruit fly larvæ on mangoes (San Blas).

From Colombia, South America—

Diaspis boisduvalii on orchids.

San José de Guatemala—

Live larvæ *Trypetidæ* sps. on mangoes.

From Hamburg—

Carlina vulgaris and *Carlina aggregata* (thistle sps.).

LOS ANGELES STATION.

Horticultural Imports.

	Parcels.
From all foreign ports	9 ships
Passed as free from pests	145
Fumigated	0
Destroyed	0
Returned	0
Contraband in ship stores or passengers' baggage	0
Total	145
From North Pacific ports	13 ships
Passed as free from pests	12
Fumigated	0
Destroyed	0
Returned	0
Total	12
By railroads from United States and foreign ports	1,336
Passed as free from pests	1,101
Fumigated	233
Destroyed	2
Returned	0
Contraband	0
Total	1,336

TOTAL FOR THE MONTH OF MAY, 1912.

Ships	22
Passed as free from pests	1,256
Fumigated	233
Destroyed	2
Returned	0
Contraband destroyed	6
Total parcels of horticultural products for month	1,491

PESTS INTERCEPTED.

From Mexico—
Chionaspis sp., *Diaspinæ*.
From Germany—
Pseudococcus citri, Diaspinæ.
From Australia—
Diaspinæ, Pseudococcus citri.
From England—
Pseudococcus citri, Saissetia oleæ, Saissetia hemisphaerica, Chionaspis sp. *Aphids*.
From Eastern States—
Chrysomphalus aurantii, Chrysomphalus ficus.
Lepidosaphes beckii, Coccinæ, Diaspinæ, Pseudococcus citri.

SAN DIEGO STATION.

Horticultural Imports.		Parcels.
From all foreign ports	42 ships	
Passed as free from pests		2,278
Fumigated		0
Destroyed		8
Returned		0
Contraband in ship stores or passenger's baggage		8
Total		2,294
From Pacific coast ports	7 ships	
Passed as free from pests		0
Fumigated		0
Destroyed		0
Returned		0
Contraband		0
Total		0
By railroad from United States and foreign points—		
Passed as free from pests		0
Fumigated		0
Destroyed		0
Returned		0
Contraband		0
Total		0
Parcels post from all points—		
Passed as free from pests		0
Fumigated		0
Destroyed		0
Returned		0
Total		0

TOTAL FOR THE MONTH OF MAY, 1912.

Ships	49	
Passed as free from pests		2,278
Fumigated		0
Destroyed		8
Returned		0
Contraband destroyed		8
Total parcels of horticultural products for month		2,294

PESTS INTERCEPTED.

Purple scale (*Lepidosaphes beckii* Newm.).
Red scale (*Chrysomphalus aurantii* Wash.).
Potato tuber moth (*Phthorimeæ operculella* Zeller).
Mealy bug (*Pseudococcus citri* Rossi).

EUREKA STATION.

From Hawaiian Islands direct---------- 3 ships
No horticultural products.
From South America---------- 1 ship
No horticultural products.

SANTA BARBARA STATION.

From Honolulu direct---------- 1 ship
No horticultural products.

In the general quarantine work of the Division the monthly reports show that the coast line from Eureka to San Diego has been watched, and a record made of all vessels arriving from all ports other than those of California, together with a statement of the horticultural products found on board, as well as importations of such products brought into the State by rail and parcels post.

At the port of San Francisco strict attention has been given to every phase of the situation, and several insect pests of more or less importance found on imports have been denied admittance into the State. However, the paramount issue at all times has been the fruit flies. In reviewing the findings of the month, it will be seen that the situation in this matter has not improved at this point. We have taken live larvæ of fruit flies in mangoes that were bought at San José de Guatemala, and found in the hand baggage of passengers leaving the vessel here, and also in commercial shipments of mangoes from San Blas, Mexico. Our previous records of *Anastrepha ludens* (the Mexican orange maggot) placed the northern limit of this pest at Colima, but this finding from San Blas has brought it about one hundred and eighty miles nearer our southern border.

Notwithstanding the promises of ship owners that the remnants of all fruit and vegetables purchased at Honolulu for ships' stores should be thrown overboard before the vessels enter Californian waters, we have, during the past month, found live larvæ of the Mediterranean fruit fly and of the melon fly in eleven different instances in this class of stores on board ships arriving from Honolulu. These instances occurred in the ships of the Pacific Mail and in the ships of the Toyo Kisen Kaisha line. Mr. Compere's statements made at the Stockton convention are all being verified by actual experience.

A careful study of the situation has convinced us that a promise that is entrusted to a hungry Chinaman for fulfillment is a poor protection against the introduction of fruit flies. We have more faith in a strict quarantine, and herewith advocate the devising of a law that will empower the horticultural quarantine officers to hold at anchor, in the bay, away from the docks, all ships arriving from infested ports until they are declared free and clean of insect pests and plant diseases by the horticultural quarantine officers.

In this matter it is but just and fair to state that so far the ships of the Matson and Oceanic lines have come in free of fruit fly materials. The officers of these companies, both afloat and ashore, have coöperated in every way to make the exclusion of this material complete, and they are entitled to a full measure of credit for their generous and capable efforts.

ORANGE SEED IMPORTED INTO CALIFORNIA.

The following is a statement of the orange seed, which has passed through my hands this season:

The importations of the citrus seed from Florida and Cuba into southern California, from January 1st to June 10th, 1912, have consisted of 127 separate lots, ranging in quantity from one gallon to eight bushels and amounting in all to 2,336 gallons or 292 bushels.

This fact alone would indicate that the citrus industry of the State is in a most flourishing condition, and that the faith of the people in its future is in no way lacking.

All of this seed was received through the Wells Fargo Express Company (with the exception of one mail order), and was held at their depot, and treated in a closed container, with carbon-bisulphid. This treatment is under the supervision of a quarantine inspector, in compliance with Quarantine Order No. 1, pertaining to the white fly (*Aleyrodes citri*), under the date of March 6, 1906, which granted permission to nurserymen and propagators to import citrus seed from white fly districts, provided it was shipped to the Quarantine Inspector and treated under his directions.

CHAS. H. VARY.

FRUIT FLY CONTROL.

FOURTH REPORT.

HONOLULU, HAWAII, March 4, 1912.

To the President and Commissioners, Board of Agriculture and Forestry, Honolulu, H. T.

GENTLEMEN: I beg to submit you a report of the work of this department for the month ending February 29, 1912, viz.:

Inspection.

Since the beginning of February there have been eight inspectors employed to cover all the districts and precincts within the quarantined area, extending from the western boundary of Waialae to the eastern side of Moanalua, but excluding the "heights" and valleys back of Honolulu. These latter sections will from now on receive as much attention as prevailing conditions and the small working force will allow.

General Conditions.

These, I am pleased to report, are much more satisfactory than they have yet been. Considering that up to a month ago only four inspectors were available under the financial conditions then prevailing, it is gratifying to find that the present fruit and pest conditions are so satisfactory. The addition of four extra men in February, made possible through the financial coöperation of California, has helped very materially in cleaning up many infested sections which could not previously be satisfactorily attended to. Continuous daily and systematic inspection of the various precincts and the coöperation of the

large majority of householders have very materially assisted in ridding the whole quarantined residential section of infested fruits. These must not, however, include the mango, which is now coming into full bearing. As a whole, I should say that the present infestation is very much less than it was during last summer before the campaign started. In previous reports I mentioned the lack of coöperation on the part of many citizens, who failed to respond when called upon to strip their trees of ripe or overripe and infested fruits. These householders, although comparatively few in numbers, have caused much extra work and have also been the cause of repeated inspections on the part of inspectors. Many have had to be continually reminded of the penalty called for by the regulations. Fortunately the department has been able up to this time to cope with the situation without having recourse to the courts, although it may be that one or two delinquents may shortly make it necessary to bring about such an undesirable proceeding. It is certain that had it not been for such lack of coöperation, conditions of infestation in some districts would be much better than they are or are likely to be.

Preliminary inspections on the "heights" and valleys back of Honolulu, all of which include the most northerly precincts in the quarantined districts, appear to show that the infestation of wild guava is by no means as great as might have been expected, in view of the conditions which existed in the residential area before the clean culture campaign started. I hope to be able to report to you further as to this as soon as the mango season is over. The full force of inspectors will be required during the next month or two to see that all fallen mangoes are daily cleaned up and thoroughly destroyed. In many cases this labor will be forced on the department, as many of the poorer householders are without yardmen and have no means of paying for any extra labor arbitrarily thrust on them.

Insular Conditions.

In my last report I referred to the condition which had made itself manifest in North Kohala, Island of Hawaii. In consequence of this, I was requested to visit the districts on Hawaii and there organize committees of control, the idea being that each district would handle its own peculiar conditions. The results of my visit and that of Mr. Ehrhorn, the superintendent of entomology, have already been submitted to you by a special report. Since my return from Hawaii your Board has adopted a new regulation (Rule XIV) having particular reference to any fruit fly conditions on the Island of Hawaii. I am pleased to report that the Governor approved of this regulation the day it was transmitted to him, and copies thereof have already been sent by me to the chairman of the committee in each of the districts of Hawaii. The regulation in question will be printed in due course.

In my last report I referred to a questionable case under observation in the laboratory, from Kona, Hawaii. I am now much pleased to say that the breeding of the fruit under suspicion produced melon fly

(*Dacus cucurbitæ*) and not the Mediterranean fruit fly (*Ceratitis capitata*). We still have other fruits under observation from Hawaii, which may have to be reported on later.

I would also report that the Attorney General is at present formulating another regulation suitable to present conditions on Maui and Lanai, where the fruit fly, as yet, has not been found. This rule will give power to local authorities on the above named islands to prevent the introduction of any Hawaiian fruit (excepting bananas and pines) at the landings. Just as soon as this regulation has been drawn it will be submitted to your board for consideration.

General Remarks.

In view of the fact that Rule X has not been found to exactly fit conditions as regards fallen fruit, your director has requested the Attorney General to formulate an amendment whereby it will be compulsory on the householder to clean up and destroy fallen mangoes and other fruit daily. This amendment will shortly be submitted to your Board for adoption or for such other action as may be deemed necessary.

Since my last report the following Honolulu fruits have been found by us to be infected with the Mediterranean fruit fly and should be added to the long list of those already reported on, viz.:

Kumquat (*Citrus japonica*).

Murraya exotica (small red fruit locally known as mock orange).

Eugenia (species).

I would further report that coffee berries, varieties of oranges, loquats, varieties of Eugenia, and "Kamani" seeds (species) appear to be among the worst infected fruits so far examined. It is not to be inferred from this, however, that other fruits are not also more or less attacked. Peaches are again coming into season and these will have to be specially watched, as that variety of fruit is one which always receives the early attention of the fly.

Application has been made by your director to the Superintendent of Education to have the teachers educate the younger scholars in the public schools as to "clean culture" methods in the fruit garden. This is intended more particularly to secure the assistance of the youngsters in keeping the grounds of their parents free of fallen fruit and the proper disposal of same. The habits of certain classes of school children as to gathering ripe mangoes from trees and throwing the refuse on the sidewalk or thoroughfare, or in undue handling of infested but otherwise fair looking fruit waiting for the garbage collector, is well known to many of us. It is quite possible that the teacher and scholar can coöperate with and assist this department on the lines suggested.

The Superintendent of Entomology has now in preparation a circular on the Mediterranean fruit fly, which, as soon as published, will be distributed to householders and to the Board of Education. This circular will no doubt be desirable as filling a much-felt want.

Mr. H. A. Weinland, representing the California Horticultural Commission, has, among other duties assigned him by that body, continued

to coöperate with the work of this department. Mr. Weinland has been paying special attention to the trapping of adult flies, as well as exploiting general conditions in and outside of the quarantined area.

Respectfully submitted.

W. M. GIFFARD,
Director Fruit Fly Control, T. H.

FRUIT FLY CONTROL.

FIFTH REPORT.

HONOLULU, HAWAII, April 4, 1912.

To the Commissioners, Board of Agriculture and Forestry, Honolulu, H. T.

GENTLEMEN—I submit you a report of the work of this department for the month ending March 31, 1912, viz:

Inspection.

During the past month the work of inspection and destruction of infested fruits has continued on the lines previously explained. The mango season is now fairly advanced and the inspection and gathering of fallen fruits are giving both householders and inspectors much work. This also applies to Kamani and other large trees bearing fleshy seeds, which are badly attacked by the fruit fly.

General Conditions.

Excepting in areas devoted to vegetable gardens, general conditions, as a whole, are more satisfactory than might have been expected at this season of the year. At the beginning of the campaign, inspection work included the areas in vegetables, which were generally attacked by melon fly, and as a result many of the Orientals were prevailed upon to gather and destroy their infested vegetables. Since the mango season has come in, however, the inspectors are obliged to devote all of their time to Mediterranean fruit fly work, and the vegetable gardens are again in bad shape in so far as melon fly is concerned. It is a difficult matter to make the Asiatic understand why he should not "plow in" his infested vegetables instead of burning them thoroughly.

I am pleased to report that, so far the mango has not shown as bad infestation of the Mediterranean fruit fly as it did last season. Many of the fruits are damaged by fungus, and as a result of fermentation are attacked by species of small vinegar flies. These latter only attack fruit in a rotting or fermenting condition.

While the majority of householders show a marked willingness to coöperate in the work of "clean culture," there are very many who appear irritated at the continual calls of inspectors. These latter householders, apparently, do not appreciate the fact that, if they kept their premises free of ripe or infested fruits, there would be little occasion for continued inspection. As a rule, however, most of the residents are pleased to have their attention called to any unsanitary horticultural conditions on their premises.

Insular Conditions.

The organization of special committees to superintend the campaign in the districts of Hawaii and Maui is now complete. Commissions have been issued to the members of committees as special agents of the board, while the inspectors named by the committees have received their official appointments.

The allotment by the "Conservation Fund Committee" of $3,500.00 to Hawaii and $1,000.00 to Maui to assist in their campaign to either control or prevent the introduction of the Mediterranean fruit fly in their several districts, has been pro-rated in a manner apparently satisfactory to all concerned. Letters of appreciation for the financial assistance granted have been received from a number of the committees. The cost of inspection, over and above the amount allotted, will be paid out of funds locally contributed in each district.

I am sorry to say that the fruit material received from Kona, about which I previously reported, has bred out the Mediterranean fruit fly. That district and Kohala are the only two on Hawaii where, so far as is at present known, infestation exists. It is to be hoped that the system of inspection at points on the belt roads leading out of Kohala and Kona will be efficient, and thereby perhaps postpone, for an indefinite period, the introduction of the fly into the other districts. As the Interisland Steam Navigation Company has given instructions to the officers on all its steamers not to carry Hawaiian fruits from infested districts, it is hoped that this coöperation, together with the vigilance of the inspectors at way ports, will greatly assist in keeping the pest away from districts so far not known to be infested.

Parasitic Work.

I am pleased to report that Professor Silvestri, the well-known expert at present employed by the Italian Government in its economic and other entomological work in southern Italy, has at last obtained leave of absence from his principals and will, at an early date, start upon the expedition to tropical West Africa in search of a parasite for the Mediterranean fruit fly and cotton boll worm. Professor Silvestri's services have been engaged for a period of twelve months.

General Remarks.

Since my last report, the following have to be added to the long list of fruits or seeds infected with Mediterranean fruit fly. These, as well as others previously named, have been bred out in the board's laboratories.

Chrysophyllum oliviforme (called Damson plum in Jamaica).

Thevetia nerifolia (locally called "Yellow Oleander).

Respectfully submitted.

W. M. GIFFARD,
Director, Fruit Fly Control, T. H.

FRUIT FLY CONTROL.

SIXTH REPORT.

HONOLULU, HAWAII, May 1, 1912.

To the Commissioners, Board of Agriculture and Forestry,
Honolulu, H. T.

GENTLEMEN—I beg to submit the report of this department for the month ending April 30, 1912, viz:

Inspection.

Inspection throughout the quarantine districts in Honolulu has continued on the same lines as previously reported, the work in general including the gathering and destroying of infested fruits having been done in as thorough a manner as local conditions would admit. The mango season is almost at its height and much of the attention of inspection has, of course, had to be given to the daily sweeping up and disposal of the fallen fruit. The percentage of mangoes found infested with the Mediterranean fruit fly is small as compared with last year. This is altogether satisfactory, in view of the fact that the crop this year is unusually large.

The department has had additional work thrust on it because of the unfortunate shortage of teams and men in the county garbage system. There have been numerous complaints from householders, who do not subscribe to the garbage department, that their fruit is not carted away regularly, but left to decay in containers on the sidewalks. The garbage department had promised to coöperate with the board to the extent that all fruit, if placed on the sidewalk in containers, within the garbage limits, would be promptly cared for, even though the householder was not a subscriber to its system. It is very unfortunate that the campaign cannot be assisted by the garbage department to the extent expected of it, and in view of existing conditions it is quite apparent that no systematic work as to efficient disposal of fruit can be expected from the county until it adopts a free garbage system and increases its equipment. In the mean time we are ourselves hauling to the incinerator as much infested fruit as our limited means will allow. A number of householders, within the garbage limits, having sufficient trash on their premises to burn their fallen fruit, prefer that method to taking chances on a weekly or bi-weekly system of collecting, as at present prevails. Furthermore, householders complain that, when the fruit is not promptly carted away from the sidewalk by the garbage department, certain classes of school children rummage the containers and distribute a part of the contents on the sidewalk, where it is left to rot unless the householder troubles himself to sweep it up. The complaints referred to are not particularly against the officials of the garbage department, as these have, from the beginning of the campaign, shown a desire to coöperate to the best of their ability. The trouble evidently lies in the fact that there is no free garbage system, and because of a shortage of teams to collect daily and bi-weekly on all thoroughfares throughout the garbage limits.

Insular Conditions.

A sample of fruit infested with the larvæ of a species of fly has been sent this department from the Waikapu district on the Island of Maui. Others gathered in Kula and Ulupalakua, Maui, by Mr. G. P. Wilder, were also turned over to us for examination. All these samples are exceedingly suspicious and it is quite probable that the Mediterranean fruit fly will be bred from at least one, if not all of them. Should such be the case and owing to the wide range of distribution, it would go far to show that, in all probability, the fly has been on Maui for some months, but for some reason or other has not been discovered by either the local authorities or residents. The same conditions may also prevail in districts on Hawaii, where, up to the present, the pest has not been discovered. It is quite unfortunate that the lack of funds prevented Hawaii and Maui from organizing and excluding Hawaiian grown fruits from their local ports at an earlier period than they did. This they and all the other islands should have done as soon as it was reported that the fruit fly existed on Oahu.

General Remarks.

As intimated in my last report, the services of Dr. F. Silvestri have been secured for a twelve months' period to search for specific parasites on the Mediterranean fruit fly and cotton boll worm. Final instructions were sent to Dr. Silvestri about three weeks ago and he is probably on his way to tropical West Africa by this time. Two or three months ago I communicated with the Minister of Agriculture for West Australia in connection with a parasite which had been introduced there some years ago, but which so far as is known, has not become established. This particular parasite was supposed to attach itself to a species closely allied to our local melon fly (*Dacus cucurbitæ*) and it has been said that it would incidentally attack the Mediterranean fruit fly (*Ceratitis capitata*). Efforts are being made by this department to secure a colony of this particular parasite for experimental purposes, but it is doubtful whether it can be obtained from Australia for the reason above stated, viz., that, so far as is at present known, it never established itself under natural conditions. On this point I expect to hear definitely in a month or more.

This department continues to receive the coöperation of the U. S. Experiment Station and has concluded arrangements with Dr. E. V. Wilcox, its director, that all parasitic material received for the fruit fly and cotton boll campaign shall be solely handled by his entomologist.

Mr. Weinland, the agent of the California State Horticultural Commission, continues to coöperate with this department in its present campaign. Besides assisting in the inspection of fruits intended for export, he is devoting much time to "trapping" and poisoned spray experiments. Mr. Weinland also keeps himself informed as to fruit fly conditions in general on Oahu.

Respectfully submitted.

W. M. GIFFARD,
Director, Fruit Fly Control, T. H.

INSECTARY DIVISION

REPORT FOR MONTH OF MAY, 1912.

By E. K. Carnes.

The following gives the total distribution of beneficial insects of all species for this month:

Beneficial insects.	Colonies.	Individual No.
Hippodamia convergens	281	9,273,000
Comys fusca	382	20,000
Novius cardinalis	122	1,830
Coccophagus lecani	85	9,500
C. messor	15	750
Various other species	---	1,000
Total	885	9,306,080

This month practically marks the end of the active shipping of a very successful season of *Hippodamia convergens,* the coccinellid which preys upon aphid species.

The total distribution for the season, so far, amounts to something over forty millions.

Up to almost the last, our cold storage facilities were very satisfactory, and the stock kept well. However, during the latter portion of the season, the cold storage plant was converted into an apartment building, and, just prior to its being torn down, the temperature in the cold storage room was allowed to rise, which had the effect of starting active movement among the hibernating colonies, with a result that a small percentage was thus lost.

This season we have received six hundred and ninety-six applications for colonies of this aphis-feeding ladybird, ranging from individual colonies of 33,000 each, for small acreage, to single applications from the large growers of cantaloupes in Imperial Valley, requesting five hundred colonies of the same size.

I am sorry to state that we have on our books orders from over one hundred applicants whose requests were received too late this season. Also numerous requests from hop growers and growers of horse beans, whom we could not supply, and whose acreage comprises such a vast area that, under our present facilities, we are unable to even attempt to furnish them with small colonies.

Applications were received from and distribution made to the following districts, which I herewith present for their value in showing the distribution of commercially destructive aphis species during the present season:

Auburn.	Aromas.	Burlingame.	Castroville.
Alameda.	Aptos.	Courtland.	Colma.
Alviso.	Brawley.	Calexico.	Colusa.
Acampo.	Bennett.	Clarksburg.	Coachella.
Alpaugh.	Biggs.	Cottonwood.	Colton.
Alton.	Berkeley.	Concord.	Corning.
Arcata.	Bowman.	Colfax.	Chico.
Antelope.	Blue Lake.	Cloverdale.	Davis.
Arroyo Grande.	Bard.	Cosumnes.	Eureka.

Elk Grove.
Escalon.
Eldridge.
El Centro.
Elsinore.
Fairoaks.
Fern.
Folsom.
Farmington.
Forestville.
Fowler.
Falk.
Ferndale.
Fortuna.
Fruitvale.
Fresno.
Gold Run.
Greenwood.
Grass Valley.
Grangeville.
Geyserville.
Guinda.
Gilroy.
Healdsburg.
Highland Springs.
Hanford.
Hayward.
Isleton.
Imperial.
Indio.
Lakeside.
Long Beach.
Livingston.
Lindsay.
Lodi.
Loomis.
Linden.
Livermore.
Laton.
Los Angeles.
Likely.
Lemoore.
Loleta.
Los Gatos.
Live Oak.
Mountain View.
Milton.
Mount Hebron.
Moneta.
Manteca.
Merced.
Murietta.
Mills Station.
Metropolitan.
Milpitas.
Marysville.
Madison.
Morgan Hill.
Niles.
Napa.
Newcastle.
National City.
Oakland.
Olinda.
Ontario.
Orangevale.
Occidental.
Oroville.
Oceano.
Oakley.
Oakdale.
Palo Alto.
Placerville.
Penryn.
Pescadero.
Petaluma.
Pepperwood.
Princeton.
Perkins.
Rio Dell.
Red Bluff.
Redding.
Rohnerville.
Riverside.
Roseville.
Ripon.
Rutherford.
Salinas.
Santa Rosa.
San Jose.
Stockton.
Sebastopol.
Sacramento.
San Francisco.
Sonoma.
Santa Cruz.
Sheldon.
San Luis Obispo.
Shellville.
Shively.
San Pablo.
Santa Paula.
Susanville.
Santa Barbara.
Santa Monica.
Swanton.
Santa Maria.
Scotia.
Santa Clara.
Soledad.
San Gabriel.
San Martin.
San Gregorio.
St. Helena.
Selma.
Saratoga.
Tulare.
Thermal.
Turlock.
Tracy.
Upland.
Ukiah.
Vallejo.
Visalia.
Vineburg.
Vorden.
Vinehill.
Vina.
Watsonville.
Woodland.
Windsor.
Wynola.
Winters.
Wallace.
Yreka.
Yam.
Yuba City.

As usual, these colonies were sent by express, the express company carrying the same free, also granting a free return on the empty crates, which places the colony in the hands of the grower without any cost to him whatsoever.

A letter, giving instructions for proper distribution of the colonies, accompanied each sending, which letter also requested the immediate return of the empty crate, and I am happy to report that the growers have been very prompt in returning our shipping crates, of which we have only about 1,200, thus enabling us to repack and ship in them a second time.

The Insectary has instituted a very careful set of experiments to determine the egg-laying and aphis-feeding capacity of this species (*Hippodamia convergens*). The feeding and care of many isolated individual pairs, sufficient to give thorough tests requiring considerable work and close application, are now, and have been during the season under way, the results of which will be published later.

A single female (*Hippodamia convergens*) has, within a period of three weeks, deposited over five hundred eggs. Other individuals, in the adult stage, have devoured as high as sixty aphids each in one day.

Some very interesting points will be brought out at the conclusion of these experiments.

The correspondence of this division, which often reaches as high as

forty letters a day, is increasing rapidly, and requires an enormous amount of labor to properly attend to this important feature of our work. A large percentage of the letters is accompanied by specimens that are submitted for identification, together with requests for various information, covering practically all the troubles that confront the growers in pursuing their chosen vocation along horticultural and agricultural lines, with special reference to insect pests and diseases. The special work of identification is one that requires time and accurate information.

The Insectary has lately attempted the work of seed testing for bona fide growers, which work seems to have met a popular demand, and which also requires considerable time and labor, both in the work of testing seeds and correspondence resulting therefrom.

Coupled with this work is that of labeling, addressing and mailing out the various colonies of beneficial insects which go forward by mail. This is regular office work—aside from the packing and shipping by express of the larger colonies.

The basic foundation of the work of this division is the introduction of beneficial insects that prey upon destructive forms, in an attempt to lower the cost of production.

In former years, provision for this work was made by the legislature for the specific purpose of insect introduction. Funds so appropriated could not be diverted into other channels; but during the last two administrations, while ample provision has been made for this very important work, the appropriation has been lumped with the general support fund of the State Commission of Horticulture, and it has been found necessary to divert the funds appropriated for this purpose into other channels; such is the case at the present time, and it has been several years since a foreign searcher has been sent to collect and introduce these beneficial forms. The funds appropriated for this purpose have been diverted to quarantine, research, and other avenues, thereby depriving this department of its real foundation upon which it must build. While this may have seemed necessary, it appears to your superintendent that additional provision should be made for the other department, and that this established state department should not be thus handicapped and deprived of its possibilities and results that are expected of it by the fruit growers of California.

The expenditure of this money is largely under the jurisdiction of the State Board of Control, and an attempt to procure even a small portion of the allotted funds for this work, during the present season, was unsuccessful.

To offset this matter, and in an attempt to carry out the purpose of the department, your superintendent has endeavored to enlist the support and coöperation of foreign entomologists, and to introduce, as far as we could, foreign beneficial insect species, through the medium of correspondence. During this month we have received a few replies to some forty letters sent out to various parts of the globe, and the follow-

ing tangible coöperation in the shape of shipments of material, supposedly carrying parasites, has been received:

From Prof. W. A. Boucher, Auckland, New Zealand.
First shipment: *Pseudococcus citri*, carrying predaceous enemy (*Cryptolaemus montrouzieri*), 8 adults; 7 dead.
Second shipment: ***Pseudococcus citri***, 5 adults; 3 dead, 2 alive.
From Prof. C. W. Hooker, Mayaguez, Porto Rico.
First shipment: *Lepidosaphes beckii*. *Chrysomphalus aonidum*. *Aspidiotiphagus citrinus* issued in considerable numbers.
Second shipment: Same material. Very few ***A. citrinus*** issued.
From Orszentmiklos, Hungary.
Two shipments, *Aspidiotus* species. A few *Aspidiotiphagus citrinus* have issued.
From Prof. C. P. Lounsbury, South Africa.
Two shipments: Internal parasite on half-grown black scale, *Saissetia oleæ*. 25 live parasites (***Aphycus lounsburyi***).

One communication from Prof. G. E. Bodkin, government biologist at Georgetown, Demerara, British Guiana, sounds very promising. We quote as follows:

> "All the four coccids you mention, the black scale, red scale, purple scale and mealy bug (*P. citri*), are to be found in British Guiana, and are all parasitized, especially the mealy bug (*P. citri*), from which I have already bred some three different species of chalcids."

Every attempt possible, through correspondence, will be made to import these parasites against the mealy bug and other scales, but parasitic introduction through the medium of correspondence is not at all satisfactory.

The following list of insect pests and diseases, together with localities from which they have been received, is hereby presented, more for its value as showing insect distribution than for the purpose of acquainting the general public with the other work and duties of this division, in addition to propagating and disseminating beneficial insects:

Pest or Disease.	Classification.	Locality.
Soft Orange Scale	*Coccus hesperidum*	Red Bluff
Purple Scale	*Lepidosaphes beckii*	*Yuba City
Harlequin Cabbage Bug	*Murgantia histrionica*	Folsom
Black Scale	*Saissetia oleæ*	Yuba City
Bean Weevil	*Bruchus obtectus*	Sacramento
Rose Mildew	*Sphærotheca pannosa*	Orangevale
Cottony Cushion Scale	*Icerya purchasi*	Belvedere
Borer in Walnut	*Chrysobothris femorata*	Fairoaks
Leaf Galls	*Cecidomyidæ*	San Rafael
Brown Apricot Scale	*Lecanium corni*	Woodland
Chaff Scale	*Parlatoria pergandii*	*San Diego
Greedy Scale	*Aspidiotus rapax*	San Diego
Clover Leaf Scale	*Pseudopeziza trifolii*	Willows
Pear Thrips	*Euthrips pyri*	Santa Rosa
Thrips	*Euthrips occidentalis*	Santa Rosa
Onion Thrips	*Euthrips tabaci*	Santa Rosa
Thrips	*Aeolothrips kuwanaii*	Santa Rosa
Greenhouse White Fly	*Aleyrodes vaporariorum*	*Orange
Orange Aphis	*Aphis gossypii*	Acampo
Palm Scale	*Diaspis boisduvalii*	*Orange
Peach Worm	*Anarsia lineatella*	Auburn
Jerusalem Cricket	*Stenopelmatus* sp.	Sacramento
Rose Aphis	*Macrosiphum rosæ*	Sacramento
Pear Blight	*Bacillus amylovorus*	Sacramento

Pest or Disease.	Classification.	Locality.
Plum Aphis	*Aphis pruni*	Orangevale
Green Apple Aphis	*Aphis pomi*	Santa Rosa
Peach leaf curl	*Exoascus deformans*	Lincoln
Pear Leaf Blister Mite	*Eriophyes pyri*	Placerville
Alfalfa Cutworm	*Noctuidæ*	Redding
Cottonwood Borer	*Aegeria apiformis*	Stockton
Wireworms	*Elateridæ*	Ripon
Puss Moth	*Notodontidæ*	Ripon
Pear June Beetle	*Serica mixta*	Marysville
Cherry Saw-fly	*Tenthredinidæ*	Placerville
Potato Scab	*Oospora scabies*	Colusa
Thrips	*Euthrips tritici*	Nevada City
Brown Day Moth	*Pseudohazis shastaensis*	Woodland
Black Peach Aphis	*Aphis persicæ-niger*	Redding
Strawberry Crown Moth	*Aegeria rutilans*	Santa Rosa
Rose Weevil	*Rhynchites bicolor*	Salinas
Cabbage Worm	*Pontia rapæ*	Courtland
Almond Red Spider	*Bryobia pratensis*	Linden
Red Spider	*Tetranychus bimaculatus*	Linden
Cherry Slug	*Eriocampa cerasi*	Colusa
Clover Butterfly	*Colias eurytheme*	Victorville
Florida White Fly	*Aleyrodes citri*	*Orange
Florida White Fly	*Aleyrodes citri*	*San Bernardino
Striped Diabrotica	*Diabrotica vittata*	Davis
Tussock Moth	*Hemerocampa*	Petaluma
Spotted Diabrotica	*Diabrotica soror*	Willows
Citrus Mealy Bug	*Pseudococcus citri*	Orange
Soldier Beetle	*Lampyridæ*	Colfax
Frosted Scale	*Eulecanium pruinosum*	Redding
Woolly Aphis	*Schizoneura lanigera*	Healdsburg
Three-lined Leaf Beetle	*Lema californica*	Marysville
Cutworms	*Noctuidæ*	Marysville
Cigarette Beetle	*Lasioderma serricorne*	Sacramento
Bedbug	*Cimex lectularius*	Sacramento
Plant Beetle	*Chrysochus cobaltinus*	Woodland
Hemispherical Scale	*Saissetia hemisphærica*	Lodi
Yellow Scale	*Chrysomphalus citrinus*	Colusa
Pine Scale	*Chionaspis pinifoliæ*	Stockton
Florida Red Scale	*Chrysomphalus aonidum*	Sacramento
Olive Knot	*Pseudomonas oleæ*	Fairoaks
Oleander Scale	*Aspidiotus hederæ*	Stockton
Root Knot	*Heterodera radicicola*	Yolo
Crown Gall	*Bacterium tumefaciens*	Antelope
Oak Root Fungus	*Armillaria mellea*	Fairoaks
Walnut Blister Mite	*Eriophyes tristriatus*	Sacramento
Peach Blight	*Coryneum beyerinkii*	Sacramento
Shothole Fungus	*Coryneum beyerinkii*	Antelope
Western Radish Maggot	*Pegomyia planipalpis*	San Francisco
Peach Root Borer	*Sanninoidea opalescens*	*Yuba City
Eastern Peach Borer	*Sanninoidea exitiosa*	*Stockton
Elm Borer	*Cerambycidæ*	Sacramento
Pear Tree Beetle	*Xyleborus xylographus*	Santa Rosa
Olive Twig Borer	*Polycaon confertus*	Courtland
Leather Jackets	*Tipula simplex*	Freeport
Hollyhock Rust	*Puccinia malvaccarum*	Willows
Clothes Moths	*Tinea* sp.	Dixon
Thrips	*Heliothrips fasciatus*	Fresno
Cicada	*Cicada* sp.	Folsom
Oak Scale	*Asterolecanium variolosum*	Stockton
Rose Scale	*Aulacaspis rosæ*	Grass Valley
Cannibal Thrips	*Cryptothrips californicus*	Vacaville
Apple Canker	*Nectria ditissima*	Eureka
Elm Scale	*Gossyparia spuria*	San Rafael
White Lined Sphinx	*Deiliphila lineata*	Napa

*In quarantine.

Pest or Disease.	Classification.	Locality.
Lace Bug	*Tingitida*	Hanford
Oak Pseudococcus	*Pseudococcus quercus*	Cache Creek
Oak Kermes	*Kermes kelloggii*	Cache Creek
Native Pulvinaria	*Pulvinaria camelicola*	Los Angeles
Grape Scale	*Pulvinaria innumerabilis*	Los Angeles
Katydid Eggs	*Scudderia* sp.	Woodland
Oyster Shell Scale	*Lepidosaphes ulmi*	San Francisco
Western Buck Moth	*Hemileuca nevadensis*	Hanford
Walnut Blight	*Pseudomonas juglandis*	San Jose
Blackberry Rust	*Gymnoconia interstitalis*	Sebastopol
Strawberry Leaf Blight	*Sphærella fragariæ*	Sebastopol
Leaf Roller	*Tortricidæ*	Santa Rosa
Codling Moth	*Carpocapsa pomonella*	Sacramento
Tarnished Plant Bug	*Lygus pratensis*	Woodland
Cypress Scale	*Diaspsis carueli*	San Jose
Currant Fly	*Epochra canadensis*	Palo Alto
Scavenger Fly	*Ortalidæ*	Vacaville
Chicken Tick	*Argas miniatus*	Sacramento
Grape Leaf Hopper	*Typhlocyba comes*	Tulare
Fuller's Rose Beetle	*Aramigus fulleri*	Los Angeles
Woodticks	*Dermacenter occidentalis*	Yolo County
Rosy Apple Aphis	*Aphis sorbi*	Antelope

For the field collecting we have one regular man, who is usually assisted by the superintendent in this work. One assistant is regularly installed at the Insectary, who fills the gap left vacant by diverting the salary of the assistant superintendent to the quarantine division, and who is on duty at Honolulu, territory of Hawaii. The work of the State Board of Horticultural Examiners, of which, by virtue of the horticultural statute, the superintendent of the Insectary is a member, and also secretary, adds much additional work to the regular office duties.

The Insectary division is glad at all times to receive insect pests or diseases from the various growers of the State, and to assist them by making determination, or diverting their specimens into the proper channel, or in any other way this division can assist the grower in producing larger crops of cleaner fruit at less cost.

EDITORIALS.

THE ALFALFA WEEVIL.

F. M. Webster of the Bureau of Entomology, U. S. Department of Agriculture, has just issued a new bulletin on the alfalfa weevil. It is Bulletin No. 112, Bureau of Entomology, entitled "Preliminary Report on the Alfalfa Weevil." The work is complete to date and should be in the hands of all county commissioners, inspectors and alfalfa growers.

SANTA BARBARA CONVENTION.

Without doubt the State Fruit Growers' Convention at Santa Barbara was one of the most enjoyable and profitable meetings ever held in the State. The papers and addresses given were of the highest order. There were 283 registered delegates in attendance. Much is due to the local residents of Santa Barbara and particularly to C. W. Beers, County Horticultural Commissioner, F. E. Kellogg, Secretary of the Chamber of Commerce, and to Milo Potter of the Potter Hotel for the comfort and success of the convention.

WEINLAND AND MEDITERRANEAN FRUIT FLY.

Mr. H. A. Weinland, who for several months has been representing the State Horticultural Commission in Hawaii in connection with the Mediterranean fruit fly situation, has been a recent visitor to this State. Mr. Weinland came to confer with the State Commissioner in order that every precaution might be taken to prevent the introduction of the fruit fly into California, and also to address the State Fruit Growers' Convention at Santa Barbara.

All who heard what he had to say about the work being done at Honolulu were impressed with his grasp of the situation in every way. Relating to his work in Hawaii, David T. Fullaway, entomologist, Hawaii Experiment Station, Honolulu, writes:

"While I have not been directly engaged in the fruit fly work, I have been in position to know all that has been going on, and I am convinced that Mr. Weinland has been keen and alert in the discharge of his duties and is thoroughly informed as to the fruit fly situation. I have often had occasion to go to the docks around steamer sailing time and have always found Mr. Weinland there with his inspectors watching fruit shipments and passengers' baggage; I have had numerous conversations with him about the fly situation and methods of control, and he has always shown a thorough appreciation of the problems involved in the work and the practical solution. I know that he has been of great assistance to the local authorities in the control work they have been attempting, and I believe that he has been thoroughly conscientious and painstaking in all his efforts to protect California's interests. I can endorse his work without any qualification."

To this may be added the endorsement of Mr. W. M. Giffard, in charge of the fruit fly control work at Honolulu, in a letter to the State Commissioner: "What I intended this letter for was to express to you the appreciation of our Commissioners and of myself of the conscientious and diligent work which your representative, Mr. Weinland, is doing in the way of inspection of export bananas, pines, etc. I do not think you could possibly secure a man so loyal to the State of California and to his immediate employers, and who would as conscientiously perform his duties as Mr. Weinland does. He is working from early morning until late at night, and in so far as your interests are concerned, delights in devising schemes of extra inspection and taking extra precautions as to export material, in order that you and your Commissioners may be satisfied."

*A FEW FACTS CONCERNING THE FRUIT FLIES OF THE WORLD.

By George Compere.

I have been requested by Dr. A. J. Cook, the State Commissioner of Horticulture, to prepare an article for publication in the "Monthly Bulletin" dealing in a general way with the fruit flies of the world.

To attempt a complete record of the findings in my twelve years of continuous search in an effort to get the facts concerning the location, the effects, and the extent to which this pest is controlled by natural methods is an undertaking, the outcome of which would be entirely beyond the scope of the proposed publication. Consequently, I have adopted the narrative form for this article, and with the assistance of my field notes, made at the time of my observations, I propose to retrace my steps and hope that at least, in mind, I will be able to take my readers with me, and have them see these occurrences as I found them.

Fourteen years ago, on November 23, 1898, I arrived at Honolulu on a special official mission. Two days later while looking around in some of the Chinese vegetable gardens I noticed that a large portion of the melons and cucumbers were very badly infested with maggots. Never was I so startled as when for the first time I cut open what appeared to be a perfectly sound melon and found the inside to be a mass of jumping white maggots. With my previous knowledge of insect pests and methods of combatting them, I promptly saw that here was something new, something far different and more serious than any insect pest we had as yet in California.

I at once began to make a thorough investigation of these gardens, and soon learned that the presence of these maggots in the melons and cucumbers was the result of their having been attacked by a species of fruit fly. After carefully watching the adult flies, their method of attack and the work of the maggots in the hosts, I then realized that sooner or later this fly would become a great source of annoyance and financial loss to the planters of the islands, and would also be a perpetual menace to the vegetable growers of California. As soon as I

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*With this issue we commence the publication of an account of perhaps the most remarkable "Odyssy" of modern times. Twelve years of continuous traveling over the world, in patient, persistent search for an object of common benefit; overcoming all obstacles in the determination to obtain—not something that would enrich himself—but something that would reduce the cost of production and increase the cutput of a great many of the necessities of life. The relation of this tale of high endeavor to accomplish a purpose of usefulness to all mankind is written by this indefatigable searcher himself, and the text employed in setting forth these remarkable facts reflects as in a mirror all the sterling qualities of his plain, practical, unostentatious personality. With the present acute interest in the Mediterranean fruit fly California should take heart from this story by George Compere, who undoubtedly has a broader knowledge of the fruit flies of the world than any other one man, and who is to-day protecting the interests of the fruit growers as a member of the quarantine force at the port of San Francisco.—Frederick Maskew.

was able to rear the flies through their life cycle, I prepared and forwarded specimens to Dr. L. O. Howard, Chief of the Bureau of Entomology, Department of Agriculture, Washington, D. C. This was the first official record of this pest, and Prof. D. W. Coquillett of the Bureau of Entomology described the fly as new to science, and it was named by him *Dacus cucurbitæ*, and is now type specimen No. 4207 in the National Museum at Washington, D. C.

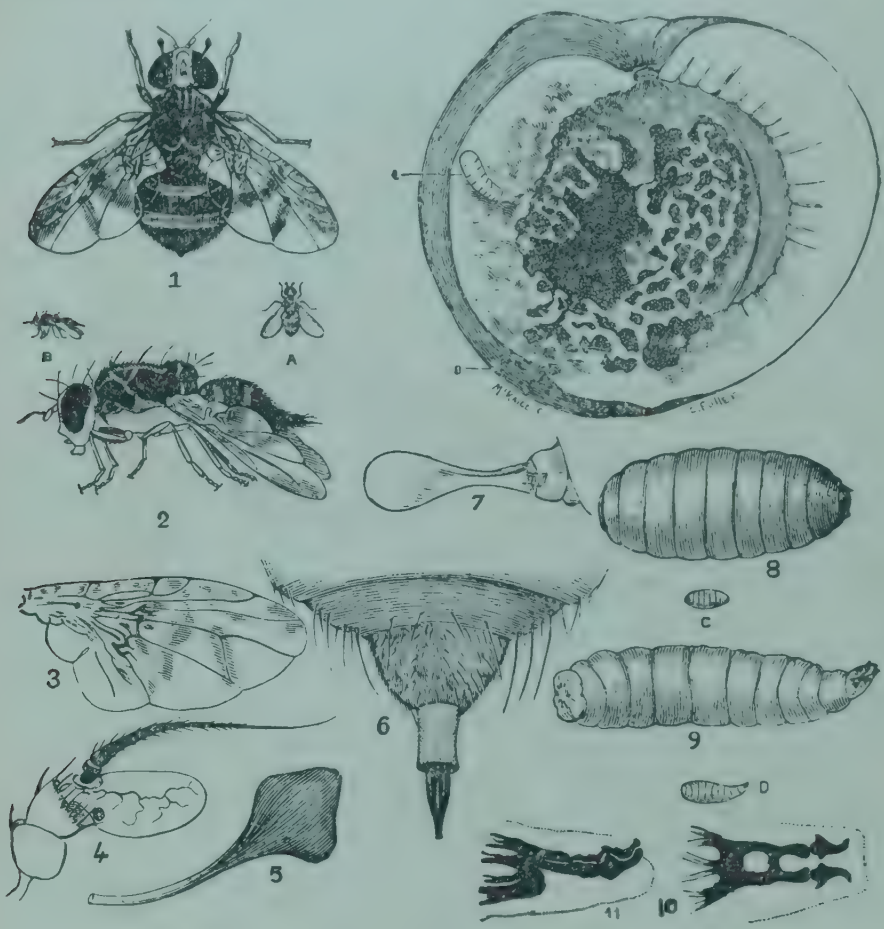


FIG. 204.—The Mediterranean fruit fly (*Ceratitis capitata*). Peach infested with maggots. 1, adult male fly; A, same (natural size), viewed from above; 2, adult female fly, viewed from side; B, same (natural size); 3, wing; 4, antenna; 5, clubbed appendage from head of male; 6, terminal segments of female abdomen, showing ovipositor; 7, halter; 8, puparium; c, same (natural size); 9, maggot or larva; c, same (natural size); 10 and 11, hooked mandibles of maggots. (After Fuller.)

In the interests of California producers I promptly informed Mr. Alexander Craw of the presence and disastrous work of this insect on the islands, and this was sufficient to cause him to prevent the further landing of infested material at San Francisco.

At Sydney, Australia, August 21, 1899, I first made the acquaintance of what is now known as the Mediterranean fruit fly (*Ceratitis capitata*). At that time I purchased a half dozen oranges at a fruit store on George street, Sydney, and two out of the six oranges I found

were infested with maggots. It being winter in Australia at that time, I was unable to determine to what extent the local orchards were infested, and having already made arrangements to proceed to the Fiji Islands, and not wishing to carry any dangerous insects about with me, I destroyed all the maggots taken from the two oranges, except one single specimen, which developed into the first specimen of *Ceratitis capitata* that had come to my observation, and I at once recognized it as being the same fly as was figured by Riley and Howard in volume 3, page 5, "Insect Life," as the peach pest of Bermuda.

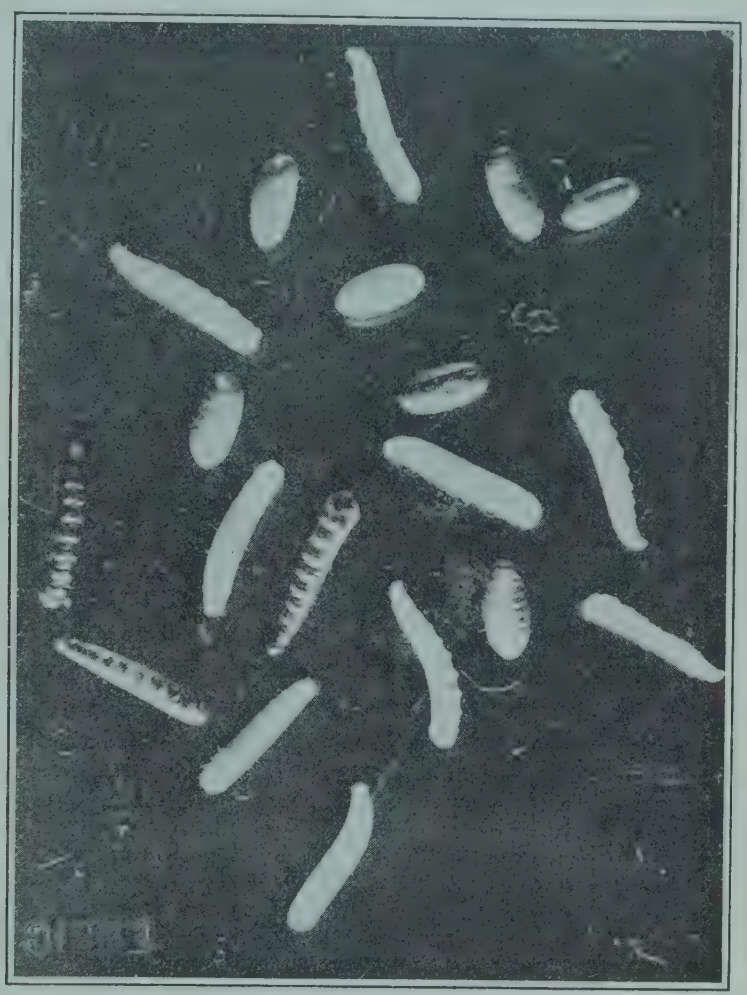


FIG. 205.—Maggots and puparia of the Mediterranean fruit fly (*Ceratitis capitata*).

September 15, 1899, I arrived at Suva, Fiji Islands, and while on those islands I was able to study some species of fruit flies there which attack guavas, pineapples, bananas and mammee apples. From maggots collected from those fruits I reared two species of flies; one species has since been named by Captain Broun of New Zealand as *Dacus zanthodes;* the specimens of the other species becoming damaged, I was unable to have them identified. At the time of my visit to the islands the citrus fruits were out of season, and the new crop was just begin-

ning to set, but information obtained from planters and others on the islands showed that fully eighty per cent of the citrus fruits are annually destroyed by the fruit fly, and I at once wrote and addressed the following letter to Mr. Alexander Craw, which was published in the Seventh Biennial Report of the State Board of Horticulture, 1899–1900, page 63, "The Fiji Government is now negotiating with the agents of the Oceanic Steamship Company to have the steamers of that line call at Fiji ports to and from Australia and California. Should they do so there will be great danger to the fruit interests of California, mangoes and other fruits being very badly infested with the maggots of fruit flies. I bred two species of flies from various fruits and was informed that about eighty per cent of their oranges became infested with maggots. The new crop is just beginning to set, so that I am unable to say what species of fly it is that attacks the oranges."

December 29, 1899, I arrived at Brisbane, Queensland, and at once began to visit the various fruit growing sections of that state or colony at that time. It was then, and not until then, that I began to realize for the first time that with all my previous years of experience with orchard pests I had in reality not seen one before I saw the destructive work of both the Mediterranean and Queensland fruit flies. In the plum, prune, peach and apricot orchards not a single fruit escaped destruction by these flies, and at Toowoomba, Queensland, Mr. Russler, of Russler Brothers, who was the owner of seven different orchards in that state, stated to me that he was unable to secure a single sound fruit from any of his various orchards, and I myself was unable to find any but very young green fruit which had not been struck by the flies.

Of all prominent growers whom I questioned with reference to the different methods of control used against the flies, none had been able to obtain satisfactory results from any of the various methods recommended; chief amongst them being the clean up of all fallen fruit, and nearly all of them had given up the hope of growing fruit in that state on a commercial basis. While it is true that there were large quantities of bananas grown in the northern sections of Queensland, and are yet, these are all grown under cover—that is to say, the banana growers (who are all Chinese) slip a muslin sack over each bunch when the fruit is about one third or half grown, and even with this protection the flies manage to strike a large number of the fruits. The fly attacking bananas in Queensland is the so-called Queensland fruit fly (*Dacus tryoni*), but which is, according to Prof. D. W. Coquillett, *Dacus zonatus*. The Mediterranean fly never did cause any great amount of damage in Queensland, owing to the fact that the other species had preceded it; in fact, no record had been made of the presence of the Mediterranean fly in Queensland before I wrote to Mr. Craw and sent him specimens of the fly January 16, 1900.

The time from December 29, 1899, up to August 6, 1900, a period which covers the fruit season of New South Wales, Victoria, South Australia, and Tasmania, was occupied entirely in searching the orchards

of these states for fruit flies. In the states of Victoria, South Australia, and Tasmania I found no trace of fruit fly in any of the orchards, but from the orchards of Queensland and New South Wales I reared fruit flies from the following fruits: peaches, plums, figs, apricots, apples,

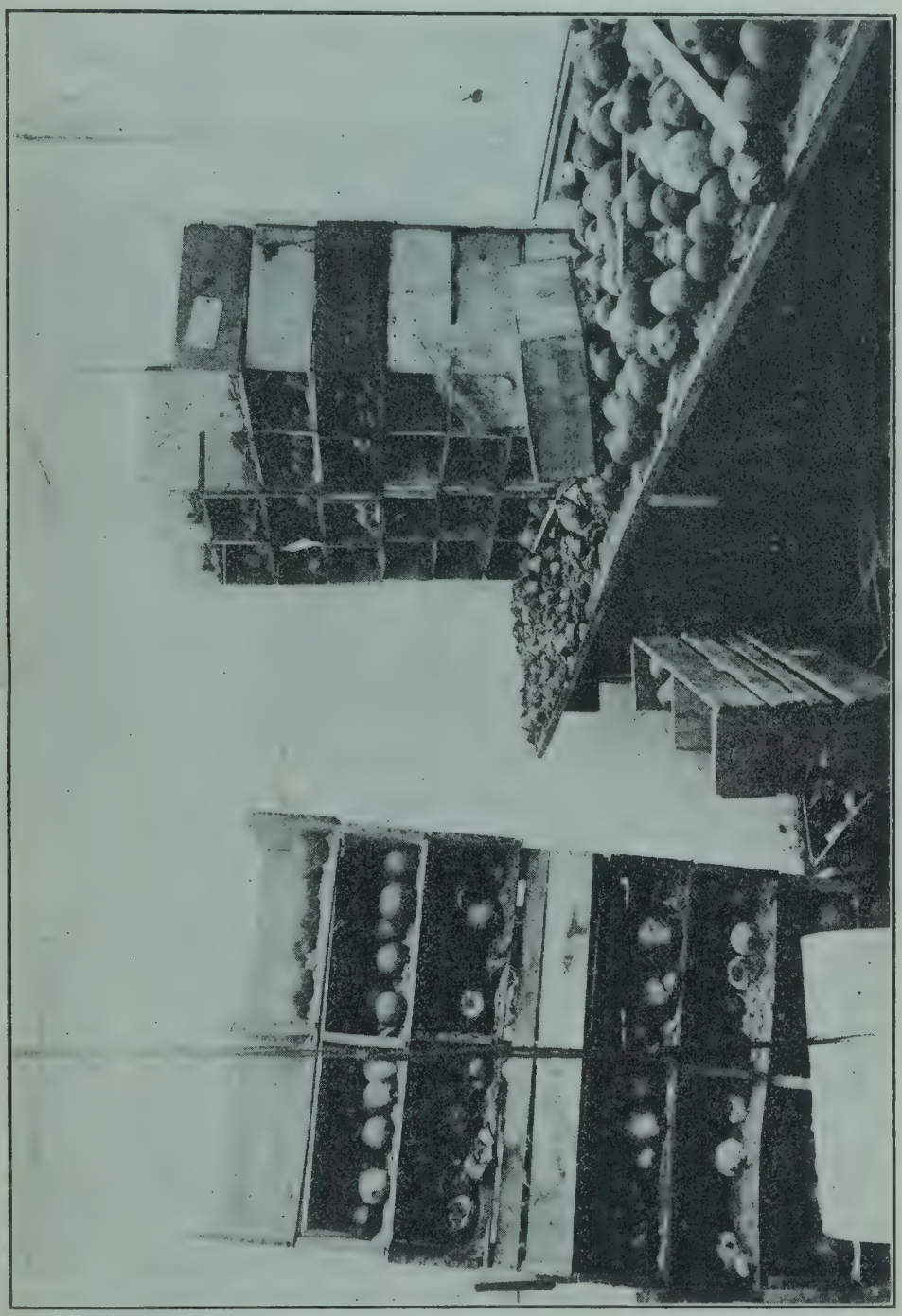


FIG. 206.—Work of the Mediterranean fruit fly, showing a consignment of assorted fruits condemned at Perth, West Australia, on account of being infested with the larvæ of *Ceratitis capitata*. (Original.)

quince, Kaki (the Japanese persimmon), oranges, limes and bananas; the so-called Queensland fly only from bananas.

On February 17, 1900, on board the steamer "Oonah," on which I took passage from Sydney to Hobart, Tasmania, there was a deck cargo

of New South Wales fruit — peaches, pears, plums and apricots — consigned to the Tasmania market, from which fruit fly maggots were emerging and springing about the deck, searching for a place to pupate, and I actually picked up during the voyage over a hundred of these maggots from the deck of the steamer. This lot of fruit was at once destroyed by the Tasmanian Government.

August 6, 1900, I left Australia for China, going via Ceylon, Java, Malay State, and Saigon. In each of these places I remained a short time, during which I made it a business early each morning to visit the public markets where the natives would bring and display for sale the fruits and vegetables of the islands. At Colombo, Ceylon, I found various fruits and vegetables infested with fruit fly maggots, but not to any great extent — the same at Batavia, Java, Singapore, and Saigon. Traveling about from place to place as I was, I did not think it wise to try and rear the flies, owing to the danger of their escaping at some new or clean section, so that I only kept alcoholic specimens of the maggots.

September 30, 1900, I arrived at Hongkong, and owing to the fact that the Boxer trouble was at its very height, I found a cable dispatch from the State Board of Horticulture ordering me to at once return to Australia, which I did, going via Manila and Thursday Island, landing again in Sydney, Australia, November 14, 1900. I remained in Australia until May 10, 1901, when, owing to the unfortunate death of Mr. Lelong, I was recalled to Sacramento, and the search for beneficial insects came to a sudden stop for the lack of funds. Arriving in California June 1, 1901, I at once settled up accounts and returned to Australia to accept a position with the West Australian Government, beginning work there the following September.

Arriving at Perth, West Australia, I at once reported to Mr. L. Lindley Cowen, then Secretary of Agriculture of that state, who at once asked me the following question: "What do you consider the worst pest we have in West Australia?" I promptly answered, "Without question the Mediterranean fruit fly is the most serious pest you have in the state." To this Mr. Cowen replied as follows: "Why, Mr. Compere, we have starved the fly out. The Government had all the fruit condemned in all the orchards where the fly had ever been known to exist in West Australia, and had the fruit picked and boiled in its green stages before the fly had any opportunity of striking it. Then we kept a corps of inspectors through the whole fruit season going through gardens where fruit had been destroyed and boiling any straggling fruit that may have set out of season. While it was a drastic as well as expensive method, yet I think it will be worth a million times what it cost." To this I replied, "I hope that you are correct and have rid the state of the fly, but I do not think you have done so, or that you ever will, and you are going to be very much surprised next summer to find the fly at work again in the orchards." Then Mr. Cowen informed me that it was the black scale which he considered the worst pest in that state, and repeated again that he was sure that they had rid the state of the fly, and

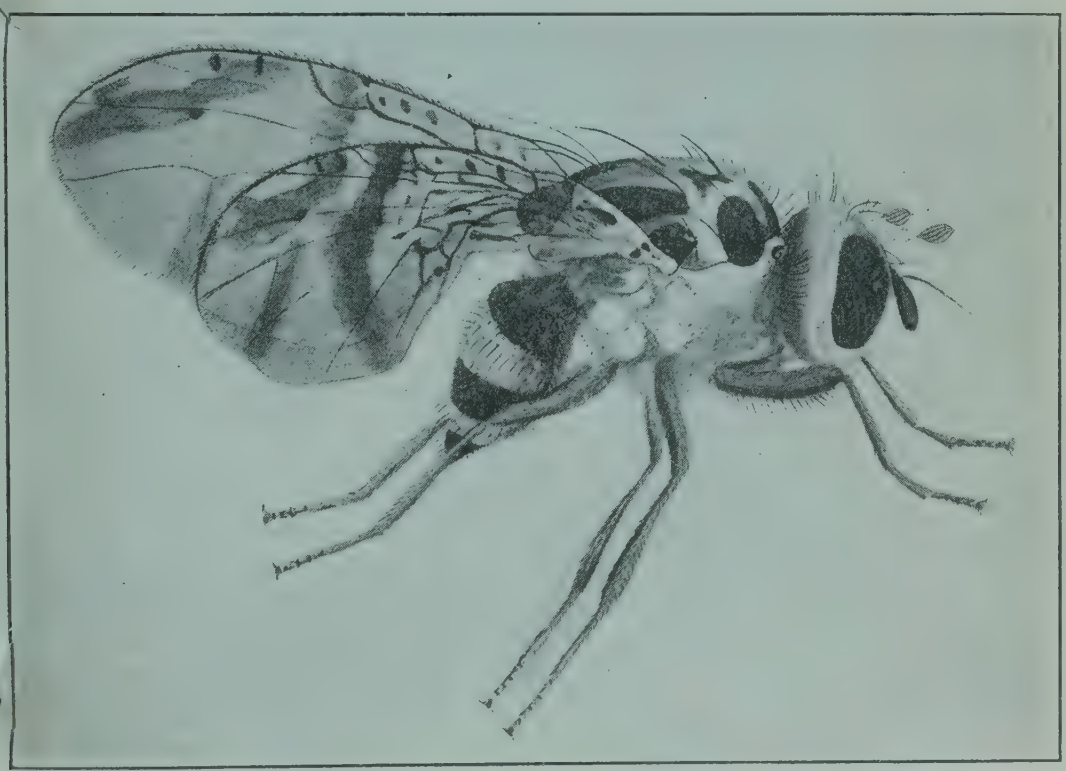


FIG. 207.—Adult Mediterranean fruit flies (*Ceratitis capitata*). Top picture, female; bottom, male. (After Birdnekoff.)

requested me to give my first attention to securing the parasite of the black scale.

From September, 1901, up to March, 1902, I remained in Western Australia, making myself acquainted with the conditions of the various orchard and garden pests there, and then left for New South Wales and Queensland to search for the parasites of the black scale. This again afforded me a further opportunity of studying the habits of the Mediterranean and Queensland fruit flies; but during the last week of August—one year after the assurances of L. Lindley Cowen that the fruit flies had been starved out—while in Queensland I received a telegram from the Secretary of Agriculture of West Australia to return at once and make preparations to go in search of the parasites and natural enemies of Mediterranean fruit fly, as it had again broken out worse than the historical plague of Egyptian locusts, notwithstanding the herculean efforts of the preceding season. This was no surprise to me, but only strengthened and confirmed my former conviction that in the fruit fly family (*Trypetidæ*) we had a pest that, owing to its prolificacy and methods of attacking the fruits, would be very difficult to handle, especially with artificial methods, for surely if the starving-out process as carried out by the West Australian Government had produced no results, the clean-culture method advocated by some Australian entomologists at that time would not accomplish much in checking these flies.

I immediately returned to Perth, West Australia, and at once began making preparations to start on what has up to the present time been one of the most difficult and persistent searches for a particular insect parasite ever undertaken by any government, and no undertaking in natural history research ever had the obstacles placed in its way that this had, and this, too, by persons who should have been the first to have assisted in making it a success.

October 2, 1902, I left Perth, West Australia, starting out via Sydney, New South Wales, on a mission that there was no knowing, at that time, to what quarters of the globe it would lead me, or the length of time and money it would require, as all the instructions I had received from the Honorable Minister of Agriculture of Western Australia was to "find the natural enemies of the Mediterranean fruit fly if possible and we will find the funds to do it with," and if any other state or country wished to join in the search, to make arrangements by which they could do so.

In New South Wales the Honorable Frank Farnell, a member of Parliament of that state, was very anxious to have his state join in with that of West Australia in the search of the fruit fly parasite, and arranged a meeting with the Honorable Minister of Agriculture of his state, who himself was very much in favor of joining with West Australia in the search, but was bitterly opposed by the Government entomologist of that state, who under no circumstances could be brought to believe in the value of parasites to fight pests.

November 6th I sailed from Sydney for Manila, Philippine Islands, but on arriving there found the cholera raging and did not land, and so proceeded to Hongkong, China, where I spent eighteen days at Canton, Amoy, and Hongkong. Near Hongkong in wild fruits (*Solanum album* and *Solanum æthiopicum*) three species of fruit flies were discovered. One of these species (*Rivellia basilaris* Wiedemann) will also attack pears, for I placed a single female specimen of the fly in a jar containing a pear on which she oviposited, and before leaving Hongkong for Japan I killed the colony of maggots taken from this pear, as I did not think it wise to carry insects of that nature from place to place alive, with always a chance of their escaping in a new locality.

From Hongkong I proceeded to Japan, but it being winter there at the time, I could make no progress in this work, and at once sailed for

FIG. 208.—Adult Mediterranean fly (*Ceratitis capitata*) at rest on an orange. (After Gurney.)

San Francisco, where I arrived January 20, 1903, and at once sounded a note of warning to the fruit growers of California about the seriousness of the fruit flies, and stated at that time that the accidental introduction of the Mediterranean or Queensland fly into this State would soon wipe out our fruit industry. (See San Francisco *Chronicle,* January 23, 1903.)

From California I proceeded to Washington, D. C., to consult with Dr. L. O. Howard and Professor Coquillett as to what information they had concerning the occurrence of the Mediterranean fruit fly in foreign countries, it being my aim to try if possible to locate the original home of this fly, as that would be the place to search for its natural enemies. Dr. Howard informed me that his department had published about all the information they had with reference to this fly. This I had

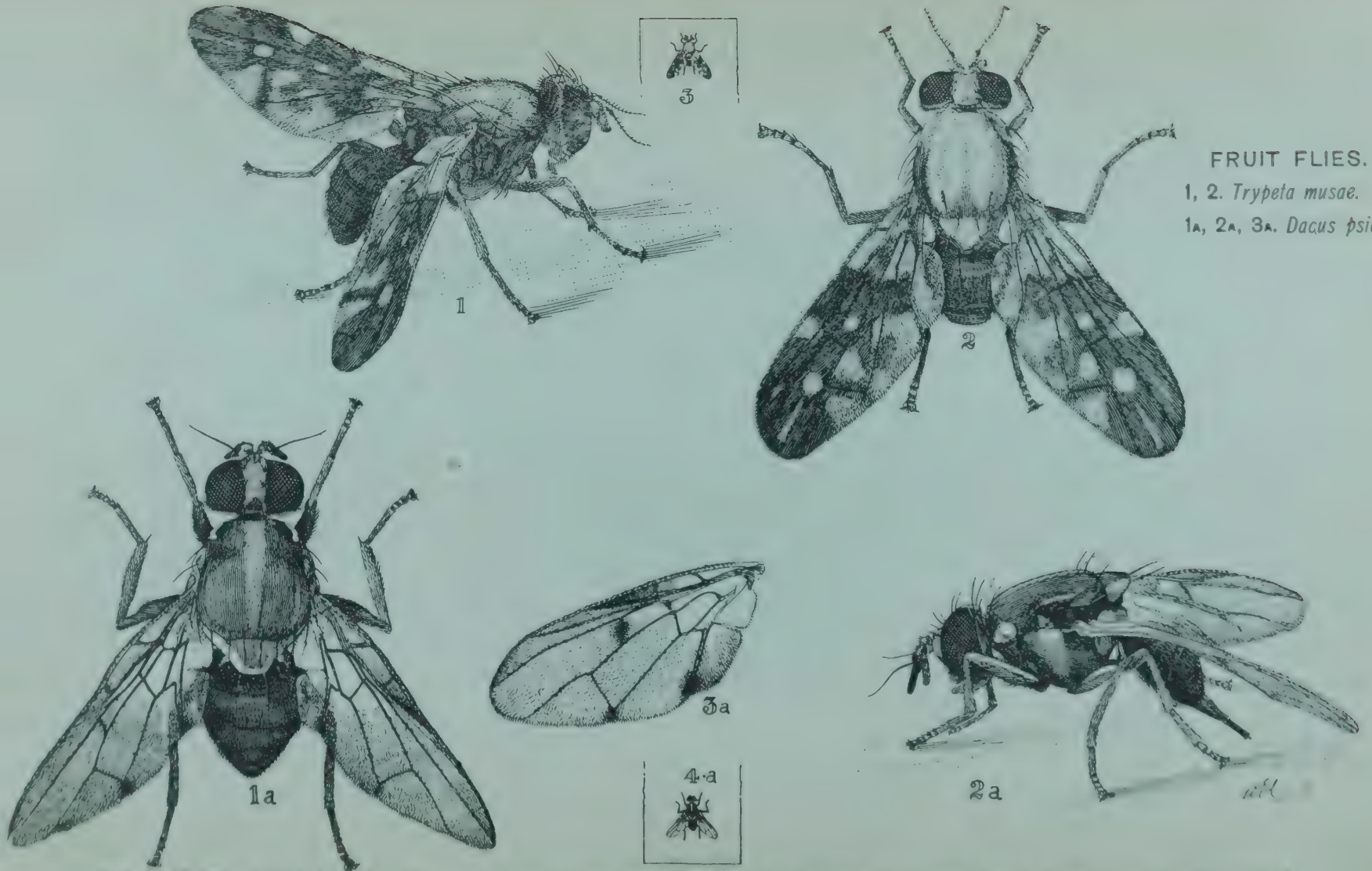


FIG. 209.—The Island fruit fly (*Trypeta musae* Frog.) and the South Sea guava fly (*Dacus psidii* Frog.) (After Froggatt.)

previously perused. However, when Professor Coquillett showed me the *Trypetidæ* collection I noticed in one of the insect boxes containing *Ceratitis capitata* specimens, there was one pin which bore label No. 575, marked Sao Paulo, Brazil, and when questioned about this vacant pin Professor Coquillett explained that two years or so previous Dr. H. Von Ihering of Sao Paulo, Brazil, had sent in a specimen of fly for identification and requested the return of the specimen, stating that it had been reared from a maggot taken from an orange; the specimen was that of *Ceratitis capitata,* and its occurrence in Brazil had not yet been published; in fact, it was not known positively at that time if it did really occur in that country, for the orange from which the fly had been reared could have come from some other part of the globe. However, a few days later I addressed the following letter to Dr. Von Ihering:

NEW YORK, March 9th, 1903.

Dr. H. Von Ihering, Caixa Do Carreio, Sao Paulo, Brazil.

DEAR SIR: While in Washington the other day I was informed by Dr. L. O. Howard, Chief of the Division of Entomology, that you had about two years ago sent specimens of a species of fruit fly to him for identification, No. 575. This was identified as *Ceratitis capitata.* Being very much interested at the present time in securing information about this particular species of fly, I have taken the liberty of addressing you upon the subject. The information wanted is, how long has this fly been known to exist in your country? What fruit has it been found to attack, and is it considered a serious pest there as it is in other countries where it has become established? If so, what methods are employed to check it? Any other information which you may be able to furnish with reference to its habits there will be highly appreciated by myself and the Government of Western Australia. This fly has become a very serious pest in some of the Australian states, and I am now on my way to the Mediterranean region to see by what method it is handled there.

Thanking you in advance for your kindness, I remain,

Very respectfully,

GEO. COMPERE.

Address letter care Department of Agriculture, Perth, Western Australia.

March 28, 1903, I arrived at Barcelona, Spain, and from there I went out into the various fruit growing sections of that province. At that season of the year there was very little material in that section for me to work upon; but the absence of peach, plum, pear and apricot trees were at once noticeable, and inquiring of the growers the reason these fruits were not more cultivated brought forth various answers. Some could give no reason at all, while others stated that they would not bear, and others that the fruit would rot and get full of worms. The apparent ignorance of the growers upon the subject of insect pests was simply astounding, for when questioned as to the nature of the worms, which they stated would get into the rotten peaches and plums they could not or would not answer the question while others only knew that they were worms; from whence they came or how they got into the fruit they apparently had no knowledge.

In olive orchards at Tortosa, Torreblanca, Amposta, Ametila, and Cambrilis I was informed that owing to the ravages of the olive fly, *Dacus oleæ,* in some seasons the crop is reduced to such an extent that it does not pay to harvest the balance left by the fly. The olive fly is

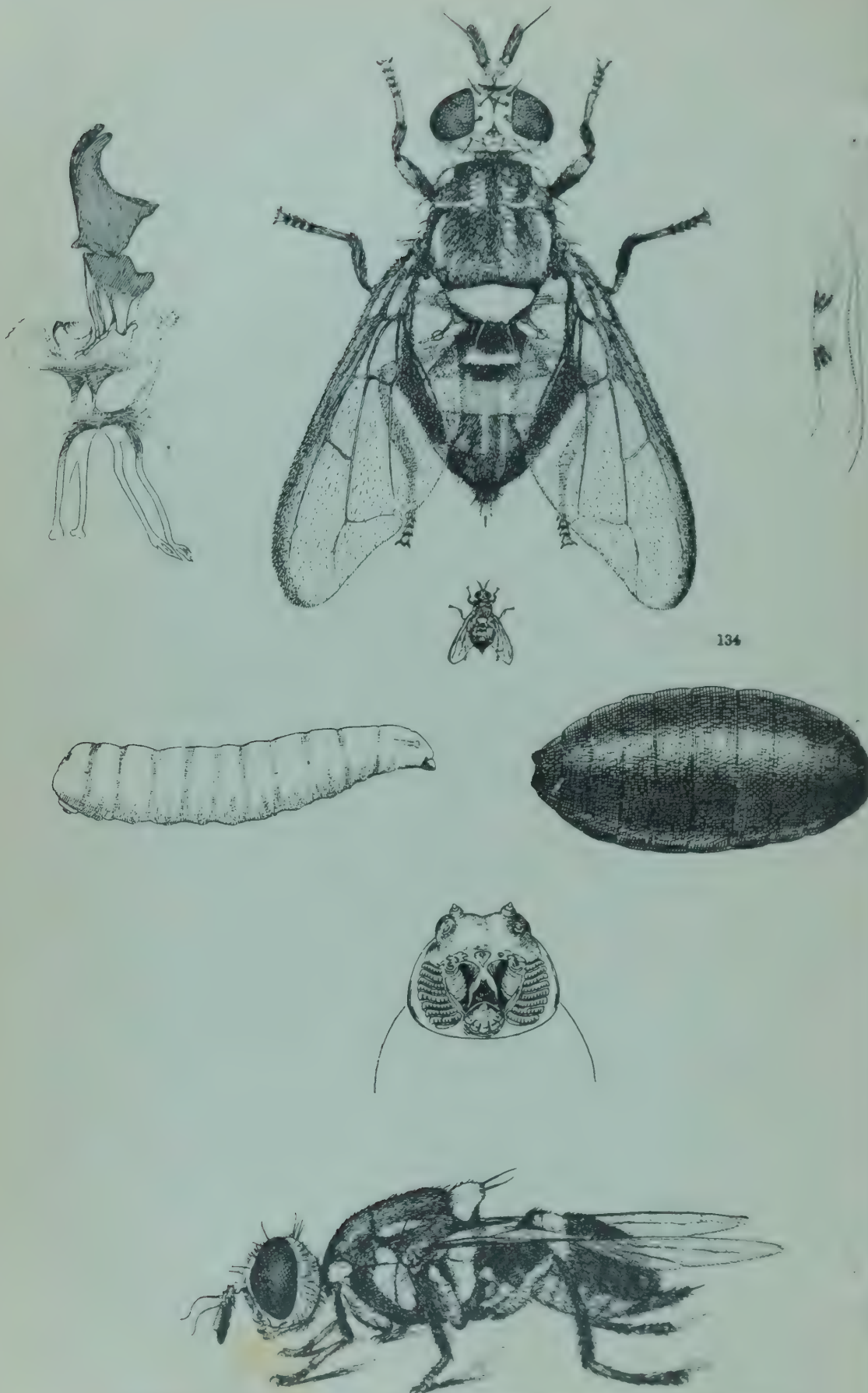


Fig. 210.—The Queensland fruit fly (*Dacus zonatus*). (After Froggatt.)

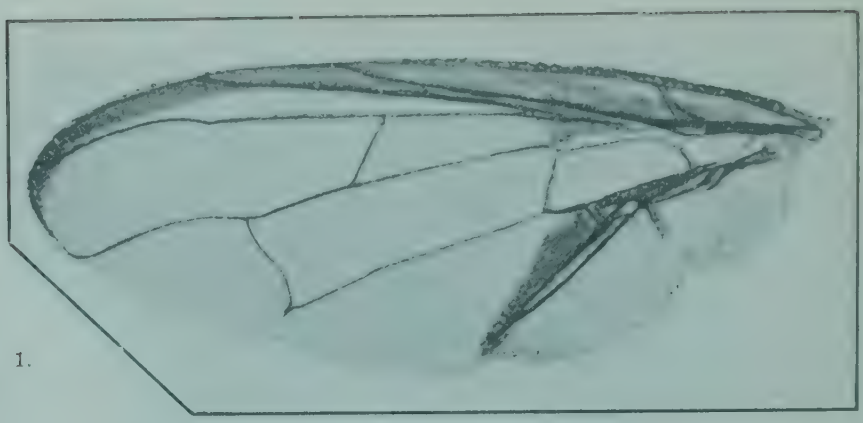
much smaller than most other species of fruit flies, and lays only one or two eggs in a single fruit. Green olives not being imported into the United States, there is very little danger of this fly ever finding its way into this country.

In the Valencia Province the peach, nectarine, plum and other varieties of drupaceous fruits are practically not cultivated there, owing to the presence of *Ceratitis capitata*. The Valencia Province is the orange producing section of Spain, and I have often been asked the question why the fly did not affect that industry there the same as it does in Australia. The reason the fly does not destroy or cause much damage to the Spanish orange crop is simply due to the fact that fruit jobbers from various large cities of Europe will purchase and harvest the bulk of the Spanish orange crop while the fruit is yet green and hard and before the fly will attack it, the oranges being brought into packing houses where they are piled up in huge piles upon the earthen floors. Women and children turn them over every few days, until they become yellow, when they are wrapped, packed and rushed to London and other large cities of Europe for the Christmas holiday trade. However, it is a fact that the late varieties of oranges grown in Spain are very severely attacked and spoiled by this fly.

At Malaga, Spain, I reared for the first time *Ceratitis capitata* from the fruit of Cactus species. From what I had been able to learn about the ravages of *Ceratitis capitata* in Spain, I knew it would be useless to expect to find any efficacious parasite there. I also learned from some of the old residents that they could well remember the time when maggots in nectarines and peaches were unknown there, and that those fruits had been grown and exported in large quantities while at the present time they were being imported from the Balearic Islands to supply the Spanish market.

Arriving in Italy, I at once called upon Professor Antonio Berlese, at the school of agriculture at Portici, and when I had made my mission known to him, he at once advised me that it would be only a waste of time and money on my part to try and find a parasite of *Ceratitis capitata* in Italy, as it was a most serious pest in parts of that country, and that he had collected thousands upon thousands of the *Ceratitis* larvæ at different times, and had never been able to rear a single parasite from them. The same was true with reference to the olive fly. Professor Berlese gave it as his opinion that neither *Ceratitis capitata* nor *Dacus oleæ* would ever be successfully controlled by artificial methods, and that the only hope of their control was in our being able to find some natural enemies. After collecting a large number of other beneficial insects in Italy I returned to West Australia to prepare for a trip to India and arrived at Fremantle, West Australia, June 11, 1903.

September 14, 1903, I sailed from West Australia for India, and arrived at Bombay September 28th. Up to the time of my leaving West Australia I had not received any reply from Dr. Von Ihering to my letter of March 9th, which I was anxiously awaiting. The first place to



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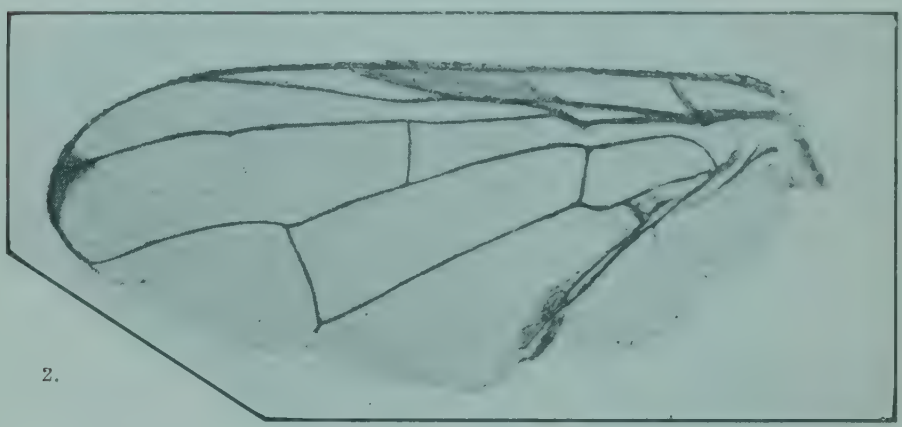

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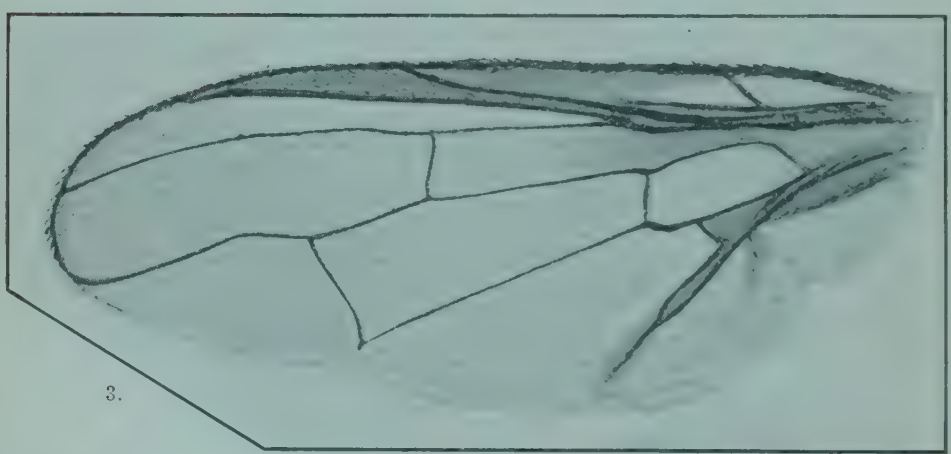

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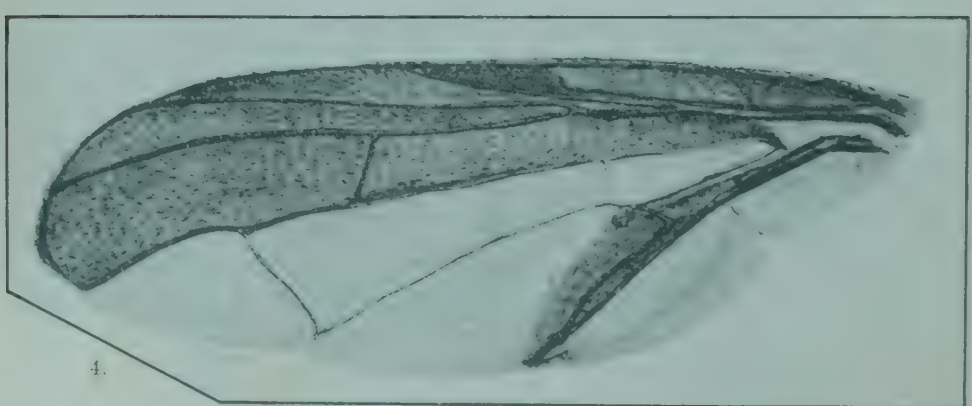

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attract my attention at Bombay was the Crawford, or public market, in which all fruits and vegetables consumed in Bombay and suburbs are handled. There I secured information as to what sections of India were producing fruits and vegetables on a commercial scale, and discovered fruit fly maggots in the following fruits and vegetables in the market:

Oranges, limes, mangoes, peaches, guavas, cucumbers, eggplant, vegetable marrow and various other species of gourds, as well as musk, or scented melons of India. After securing maggots from all the fruits and vegetables mentioned and placing the same in breeding tubes, I left Bombay for Poona, which is quite an important fruit producing section. Any number of oranges and cucumbers were found at this point which had been struck by some species of fruit fly. Two species, *Rivellia persicæ* and *Dacus diversus,* were seen in the act of ovipositing in oranges, and at Kuivla, about twenty miles out of Poona, the same flies were noticed attacking the sweet limes. The cucumber and melon fly, *Dacus cucurbitæ,* were also noticed in and around Poona. I at once informed the Hawaiian Government of its occurrence in India, and this was the first time that it had ever been recorded from any place outside of Hawaii.

From Poona I made a trip to Nagpur, another fruit producing section, and there *Rivellia persidæ* was taken on the wing, and maggots secured from oranges later produced the same species, and also *Dacus diversus.*

October 10, 1903, I arrived at Calcutta, and during my stay there was able to secure varieties of fruits and vegetables additional to those found at Bombay, Poona and Nagpur, among them some pears which had been grown in the Dargiling district and also alligator pears infested with maggots. Just what section the avocado was grown in I never learned. The adult flies reared from these pears proved to be *Dacus ferrugineus.* On the day of my arrival at Calcutta I received among the mail awaiting me the following letter, an answer to my letter addressed to Dr. H. Von Ihering, at Sao Paulo, Brazil, from New York on March 9, 1903:

SAO PAULO, BRAZIL, 25th July, 1903.

Museu Paulista. Director Dr. H. Von Ihering.

DEAR SIR: I have received your letter of the 9th of March. The fruit fly, to which you refer, is not here so frequent and pernicious as in your country. Five or six years ago this fly has been observed in Sao Paulo; nevertheless it has not increased much until now. I have found in oranges chrysalis of *Ceratitis capitata* Wied. of the family *Trypetidæ,* a species of vast distribution geographically. Another species of the same family, *Anastrepha fraterculus,* attack psidium guava, guagava raddi, and coffee berries; another similar species, *Trypheta bisenata* Loew., produce gall nuts formed by swellings of the branches of a sylvan species of vemonia, which is very frequent here. I am sorry that I cannot send you my paper about this subject published in the Rivista Agricola, Sao Paulo, 1901, because I do not possess any more copies of it. It will be interesting for me to obtain your paper containing the results of your study, especially with regard to the respective treatments. I have recommended as one of the most important means the rapid collection and destruction of all fallen fruits.

(Signed) H. VON IHERING.

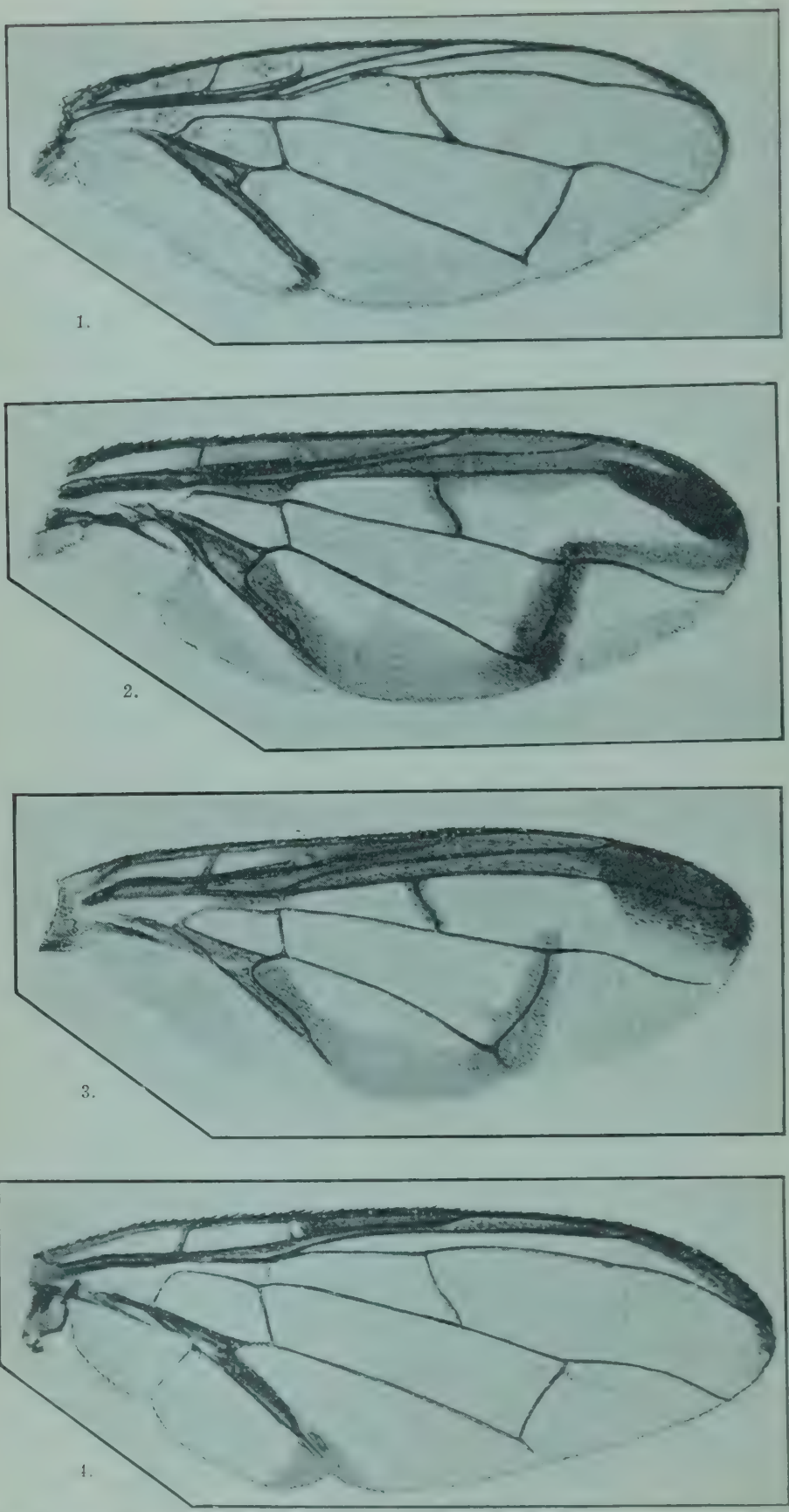


FIG. 212.—Wings of fruit flies (after Froggatt). 1, The peach fruit fly (*Dacus persicæ* Bigot.); 2, the melon or bitter gourd fruit fly (*Dacus cucurbitæ* Coq.) in

October 18, 1903, I arrived at Madras and unpacking the material which I had collected at Bombay and Poona, found that I had many species of fruit flies. *Dacus cucurbitæ* and *Carpomyia pardalina* were the two species reared from melons and cucumbers. *Carpomyia pardalina* is, as far as I know, strictly a melon pest. I did not find any in cucumbers or other vegetables while in India and I might state that this fly is a very closely allied form to *Ceratitis capitata.* From oranges, mangoes, guavas and sweet limes I reared *Dacus longicornis, Dacus diversus* and *Dacus ferrugineus.* In and about the vicinity of Madras there is little fruit or vegetables grown, the supply being drawn from the Bangalore district, which was the next place I visited. Here I found about the same fruits and vegetables infested with maggots as in the other sections of India which I had up to that time visited, with an additional variety of fruit infested with maggots; this was the wild fig and the flies reared were *Dacus zonatus.* No trace of the Mediterranean fruit fly was found in India.

The next place to visit was Ceylon, where I spent four days in and around the city of Colombo, and found oranges, cucumbers, eggplant and some other native fruits infested with fruit fly maggots, but being on my way to Australia I did not have the time then to visit any of the hill districts.

Before arriving at Perth, West Australia, all of the flies had emerged from the last material I had collected. There were about twenty species of fruit flies, but not a single specimen of *Ceratitis capitata* was found among them. November 12, 1903, I arrived at Perth and January 7, 1904, I left there for Brazil, going via Sydney, San Francisco, and New York. February 22, 1904, I arrived in San Francisco and I again called the attention of California to the seriousness of the Mediterranean fruit fly and a splendid illustration of the fly appeared in the issue of the *California Fruit Grower* February 27, 1904.

April 26, 1904, I arrived at Sao Paulo, Brazil, and on the following day visited some orange gardens in the Santa Ann district. Inquiring of the owners regarding fruit flies I was able to learn nothing as none seemed to know anything about them and had not noticed any maggots in their fruit. Securing permission of owners to inspect their orchards I soon discovered fruit fly present, but not in such numbers as would attract their attention.

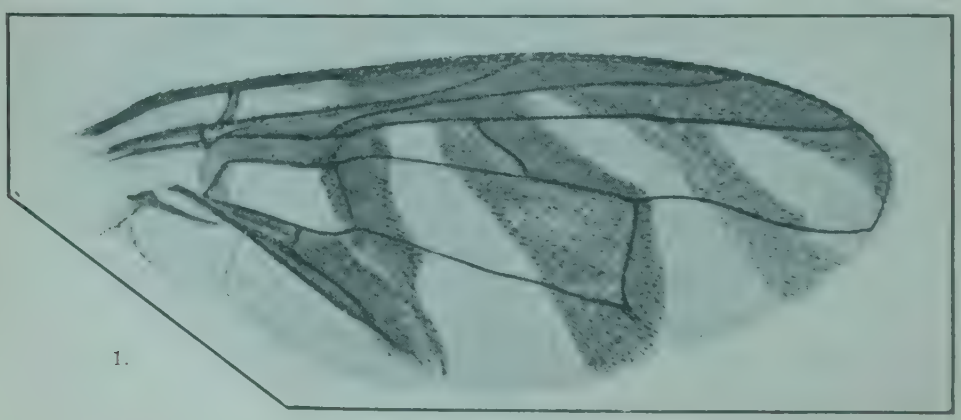
Next I called upon Dr. H. Von Ihering at his residence, but owing to a serious illness in his family at the time he was unable to leave his home to accompany me to any of the orchards, but informed me that the Mediterranean frut fly did very little damage to oranges there; that sometimes peaches would be found infested with maggots, but little was known about fruit flies there. As far as he knew there never had been any parasites discovered which held them in check, and there was no artificial method employed against fruit flies in that country as far as he was aware.

Seeing that I could make no headway by calling upon officials, I

decided to visit the orchards and see for myself what was to be found there, and during my stay in that section I visited Tambata, Sao Caetana, Mooca, and Sao Bernardo, at all of which places oranges are cultivated, and none of the owners had ever noticed any damage to them by maggots. By diligent searching day after day from early morning until late in the evening I managed to find occasional fruits infested with maggots from which I reared seven species of fruit flies, *Trypeta fraterculus*, *Ceratitis capitata*, *Dacus brævipes*, *Dacus serpentinus*, *Dacus bicolor*, *Dacus parallelus*, and *Trypeta ludens*. These flies were reared from oranges, Japanese persimmons and other fruits, and while investigating them at Sao Paulo, I also discovered what natural checks were at work there.

The next place to visit was Bahia, where there was a larger variety of native fruits ripe at that time, the following fruits being in season:

Sapodilla plum (*Sapta achras*), (*Patanga patangueria*), (*Genipa americana*), *Grumixameria*, a fruit called Caja by the natives, oranges, limes and guavas. I remained at Bahia eleven days, during which time I worked early and late, and in addition to the seven species of fruit flies reared from Sao Paulo I secured several other species which have up to the present time not been determined. *Ceratitis capitata* was also present. Several species of braconid parasites were observed hunting out infested fruits and ovipositing in the larvæ of the fruit flies. Two of these species had been observed doing the same at Sao Paulo. There was also present a staphylinid beetle which had been noticed at Sao Paulo feeding upon the fruit fly maggots. The manner in which these parasites and predaceous insects indiscriminately attacked the various species of fruit fly larvæ demonstrated to me that it would be a very difficult matter to discover a specific parasite on *Ceratitis capitata* and we could eliminate for the time the native habitat of *Ceratitis capitata* and introduce to West Australia all the various species of fruit fly parasites discovered in India and Ceylon working on the native fruit flies there. There was not a single person in and about the Bahia district who had ever noticed any fruit flies; none of the owners of the larger orange groves had ever seen one up to the time that I called their attention to their being present. This surely was



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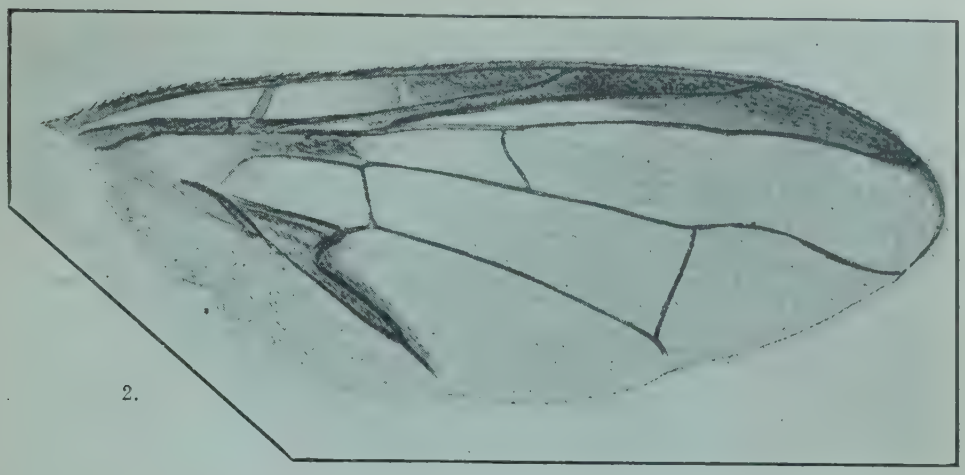

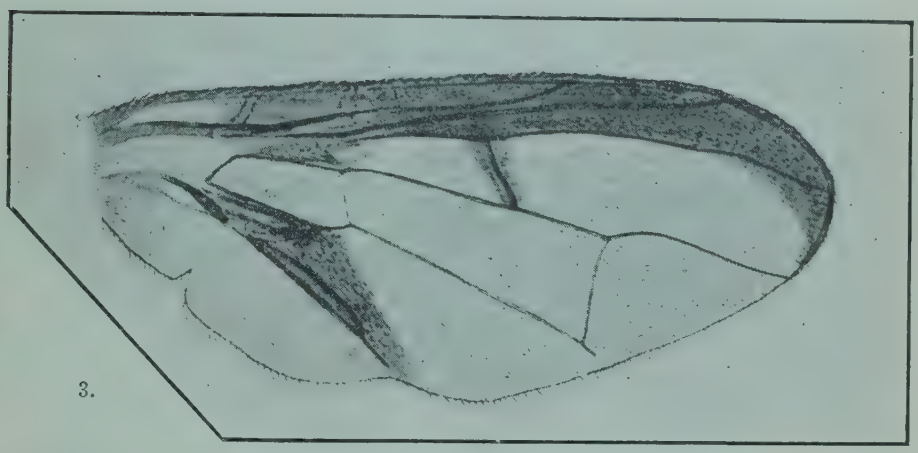

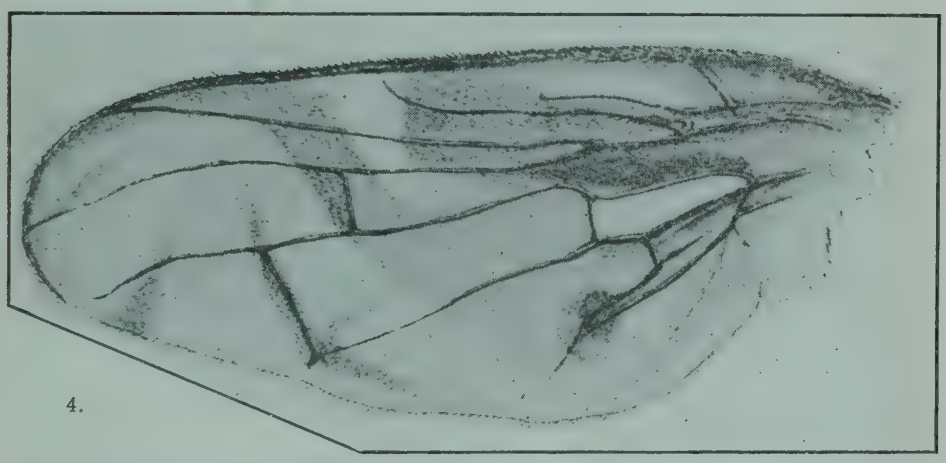

FIG. 213.—Wings of fruit flies (after Froggatt). 1, French's fruit fly (*Dacus frenchi* Frog.); 2, *Dacus ornatissimus* Frog.; 3, *Dacus curvipennis* Frog.; 4, the Mexican orange maggot (*Anastrepha ludens* Loew.).

enough to demonstrate to any sane person that the various species of fruit flies were being held in subjection by natural enemies for if not so there would not, with all the various species of flies present, be a single fruit left to ripen.

There were several very serious and difficult problems in connection with my mission which I had to first overcome before any parasites of the fruit flies of Brazil could be landed in West Australia. The first was the long distance between the two countries which required forty-six days continuous travel by the fastest mail lines; then the great danger there might be in introducing other species of fruit flies into West Australia; also, to obtain enough of the parasitized pupæ of the fruit flies to make it worth while making the trip, and to secure a sufficient amount of fresh maggots on which to feed the staphylinid beetles during the long journey. There was also to be taken into consideration even if I succeeded in landing my material in good condition in West Australia, what would the conditions be in the latter place when I arrived, which I had figured would be about the middle of July. This was the middle of winter there and no fruit fly maggots would be present.

FIG. 214.—The adult female of the Mexican orange maggot (*Anastrepha ludens*). (U. S. Dept. Agrcl.)

To obtain material from which to secure the braconid parasites I covered a Pitanga tree on which the fruit was just beginning to ripen and captured as many fruit flies on the wing as possible and liberated them under the cover, several specimens of *Ceratitis capitata* being among them. Some of the flies did not take kindly to their imprisonment and flew to the sides of the cloth while others began at once to attack the fruit. The cover was allowed to remain on the tree for five days when it was removed and the maggot-infested fruits exposed to the parasites. Two days after the cover had been removed dozens of parasites could be noticed working among the infested fruits. The tenth day after covering, all fruit was picked off and placed in boxes, and on the eleventh day I sailed from Bahia for Southampton on the steamer "Nile," (now plying between San Francisco and Hongkong). I kept the infested fruits in a cool place until all the maggots had fully developed, when the pupæ were placed in the cool chamber of the ship where I allowed them to remain during the remainder of the voyage.

With the staphylinid beetles (*Huamerocera brasiliensis*) I had a very different problem to solve—how to get them alive to West Australia.

To collect too many of the beetles would require an immense amount of maggots to feed them during the long journey and to place them in the cool chamber of the ship, risked a possibility of their not surviving the journey. The plan which I decided on was to place some in the cool chamber with food, some without any food, and to take one lot in my cabin and feed them on blowfly maggots during the voyage. July 12th I arrived at Perth, West Australia. The voyage occupied just forty-six days. During the journey I purchased from Peek & Son, Gray's Inn, London, England, two gallons of blowfly maggots, or gentles, as they are called there, where it is the custom to use them for fish bait. The staphylinid beetles which I had kept in my cabin and fed every day on blowfly maggots, survived the journey in splendid condition with some young larvæ of these beetles also reared on the journey.

Of the two hundred and fifty fruit fly pupæ which had been in the cool chamber two hundred were found to be parasitized and fifty contained fruit flies, which were at once destroyed. The parasitized pupæ were mostly all placed again in the Government cold storage chambers at Perth to retard development until such time as there would be fruit fly maggots to turn them loose on, while the staphylinid beetles were at once liberated. But there were no fruit fly maggots at that time in the orchards, it being mid-winter, and the chances of their establishing themselves were very slight. However, I had the satisfaction of knowing that it was possible to land these beneficial insects alive in West Australia.[1]

After making out and submitting a report of the Brazilian trip to the Director of Agriculture at Perth, West Australia, I left that State for a trip to Spain, going via the Suez Canal, to collect and send to this State the codling moth parasite, which I had discovered in that country on a previous visit.

Arriving at Port Said I broke the journey to investigate the fruit fly in Asiatic Turkey, for while on my way from Brazil to Australia I noticed that the apricots offered for sale at the local fruit stores at Port Said were badly infested with the larvæ of fruit fly, from which I reared *Ceratitis capitata*, and as I had been unable to find any previous record of the fly occurring in that section I decided to make a personal investigation of it.

From Port Said I crossed over to Beirut, and it did not require much investigating there to find *Ceratitis capitata*, and the same at Jaffa and

[1]That the readers may not become confused in following this narrative it will be necessary to state that when I arrived in San Francisco February 22, 1904, as previously mentioned, I was solely employed by the West Australian Government, but during my short stay in this State at that time an arrangement was entered into between his excellency Governor George C. Pardee and the Honorable Ellwood Cooper, at that time State Commissioner of Horticulture, and myself, by which California was to share half of my expense with the West Australian Government in the search of beneficial insects, and this State was to share the benefits of my researches. Under that arrangement I continued to work up to November 5, 1910, when I tendered my resignation to the West Australian Government, and also ceased searching for beneficial insects for this State. In future issues of The Monthly Bulletin I shall explain my reason for discontinuing the search for beneficial insects, and shall also give a list of all the material which was sent to the State Insectary at Sacramento and to West Australia.

Jerusalem. It was almost impossible to find a fruit in any of those places which was free from maggots, even the fruits of the pomegranate being infested with them. If there were any virtue in the clean culture method, as some inexperienced entomologists claim, it surely has no effect on the net results of the destructive work of the flies in the three places above mentioned, for there, not a single fruit which falls to the ground is allowed to remain for any length of time.

FIG. 216.—a, stem showing galls; b, lower gall of "a" cut open showing pupa. (Original.)

WISTARIA GALL FLY.

*Agromyza schineri (Giraud).

By EDW. O. AMUNDSEN.

A shipment of nursery stock and ornamentals, which arrived from Japan about the first of March of the present year, consigned to a Los Angeles nursery, included several hundred Wistarias. Among other infestations found, while the writer was helping with the inspection of this shipment, was the presence of gall formations upon the stems of many of these at the base of the buds. (Fig. 216.)

Out of the total number of plants about forty or more were found infected with these galls. All of these were subjected to a rigid inspection and every one infested was put apart from the uninfested. Translation of the writing on the tags revealed the curious fact that all of the infested plants produced pink flowers while the healthy produced other

*We are indebted to Prof. J. M. Aldrich for the determination of this species. He reports it as occurring in Europe, Egypt and North America, besides the present record from Japan.

colors. Whether the fly which laid the eggs discriminated against all plants which ultimately would produce flowers of other colors and could pick out the pinks, or whether the pink varieties were grown in a different locality than the others, could not be ascertained and is still a mystery. It is hoped that inquiries now being pursued will throw some light upon these points.

The size of the galls varied but slightly, and each when cut open revealed a single white, typical, dipterous maggot or worm-like larva, in the midst of a mass of decayed tissue and excrement. (Fig. 216.)

Life History.

The first part of the life history of the gall fly is a matter of conjecture suggested by the typical life history of related species and by observation of the position of the larva and the nature of the host plant.

The egg is probably laid in the bud just as it begins to open. The

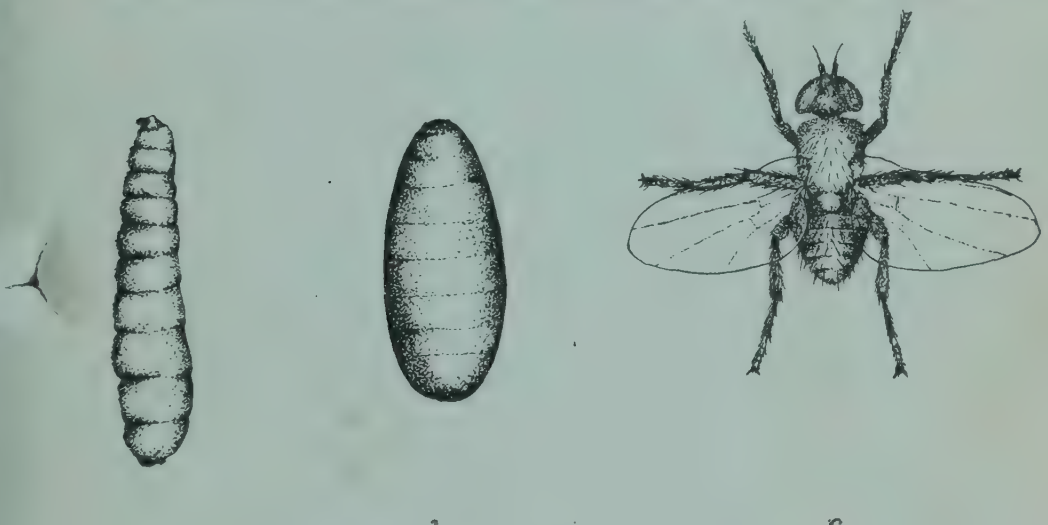

FIG. 217.—a, larva of Wistaria gall fly (*Agromyza schineri*); b. pupa; c, adult. (Original.)

larva, hatching from the egg, being negatively phototropic, would naturally crawl down to the base of the bud and begin feeding on the tissues. In closely related species the larval stage lasts about eight to ten days. The pupa stage is passed in the bud-base and occupies about ten days. The perfect insect or adult then emerges by piercing the pupa case and plant tissue. (The exit hole is shown in Fig. 216, in the lower gall.)

The age of the adult at the time of egg-laying has not been determined but it is very likely that there would be several generations a year in a climate such as prevails in California.

Descriptions of Stages in Life Cycle.

Egg.—As the insect was first observed in the larval stage and the adults bred from these were not kept in suitable places for egg laying, on account of lack of facilities, the egg cannot be described at this

time. However, the egg in all probability would resemble that of related species.

Larva (Fig 217 a).—The larva is a white, tapering, typically dipterous, 10 segmented maggot, 5 mm. long and 1.25 mm. in diameter through the largest segment.

Pupa (Fig. 217 b).—The pupa is dark brown, egg-shaped, slightly

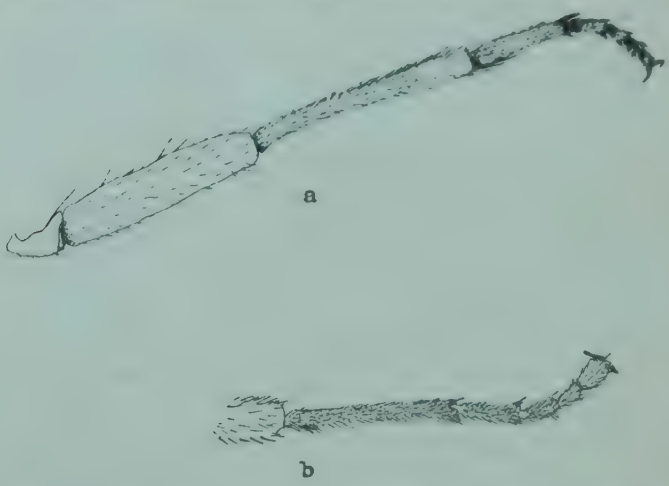

FIG. 218.—a. posterior leg, showing the first tarsal joint longer than other joints; b, tarsi. (Original.)

flattened on one side, 4 mm. long and 1.75 mm. through the largest diameter. Circumscribing lines of small circular dots divide it into ten rather faint segments.

Adult (Fig. 217 c).—The adult is a small, black fly, 3.25 mm. long. Body rather densely covered with hairs. Femurs sparsely covered

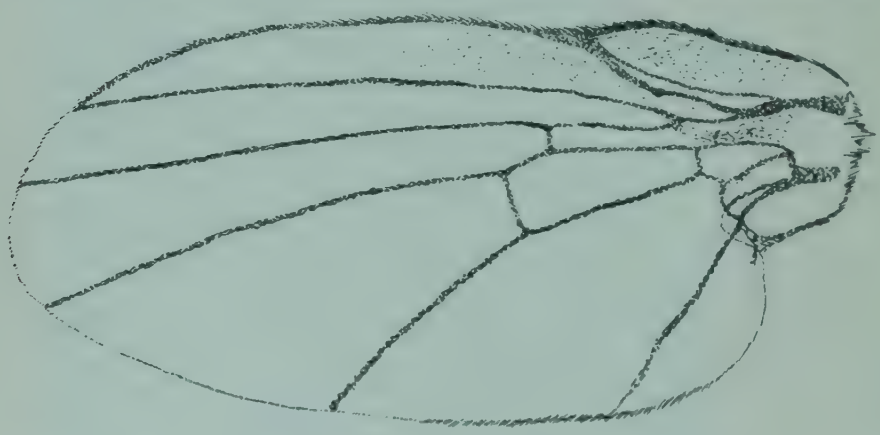

FIG. 219.—Wing of Wistaria gall fly. (Original.)

with hairs, tibia and tarsi rather densely covered. Tarsi five jointed, the first joint being long and slender as compared with other joints. (Fig. 218.)

There is a pair of membranous wings 3 mm. long, as shown in Fig. 219, and a pair of halteres.

Eyes large, reddish-brown.

Injury Caused to the Wistaria.

Most, if not all, of the buds attacked, live but a short time as the tissue immediately at the base and extending up or down in the stem, according to the direction in which the larva works, for one quarter to a half inch, is consumed and is filled with frass. After the emergency of the adult the pupa case may be found in this cavity. The exit hole may furnish the opportunity for the entrance of parasitic fungi which may do more damage than the initial invader.

THE POTATO WART DISEASE.

Caused by a Dangerous Fungous Pest That Should be Guarded Against by California.

(Chrysophlyctis endobiotica Schilb.)

By H. S. Fawcett.

The potato wart disease has already spread apparently from Upper Hungary, where it was first reported, through Germany and England, and has appeared in Scandinavia, France, and Italy, and was found in 1909 in Newfoundland. It is a very destructive disease. In England, in the worse cases, seventy-five per cent up to the entire crop is reported to be affected. Since there is great danger of the disease being brought into this country every one should be on guard against its possible introduction. Many thousand bushels of potatoes are being shipped here annually from infested countries.

The following is an abstract from Farmers' Bulletin, No. 489, by Perley Spaulding and Ethel C. Field, issued April 9, 1912: Potatoes rank as one of the most important farm products in this country. The Yearbook of the United States Department of Agriculture for 1910 estimated the production of that year at 328,787,000 bushels. Consequently, much alarm is felt over the probable introduction of the potato wart. The close proximity of the disease to the United States makes it imperative that steps should be taken to guard against its importation.

The wart disease is one which principally attacks the tubers, causing the formation of wrinkled, warty excrescences, which have given rise to the names "warty disease," "black scab," "canker," and "cauliflower disease" (Fig. 220). Since the tuber is the part of the plant chiefly affected, it is difficult to ascertain the presence of the disease until harvesting time.

The organism *Chrysophlyctis endobiotica* Schilb., which is the cause of the disease, gains entrance into the tuber through the tender tissue at the eyes. In a mild attack the eyes first appear grayish, then brown, and finally black, while in a healthy tuber they are whitish or purplish in color. It is very difficult, if not impossible, to ascertain the presence of the disease in this stage. Such potatoes, when used as seed, prove to be the source of new infections wherever planted. It is due to this failure to recognize the disease in its early stages that potato wart has

spread with such rapidity. In more advanced stages the disease is very apparent. One or more nodules, varying in size from that of a wrinkled pea to lumps as large or larger than the tuber itself, may be found (Fig.

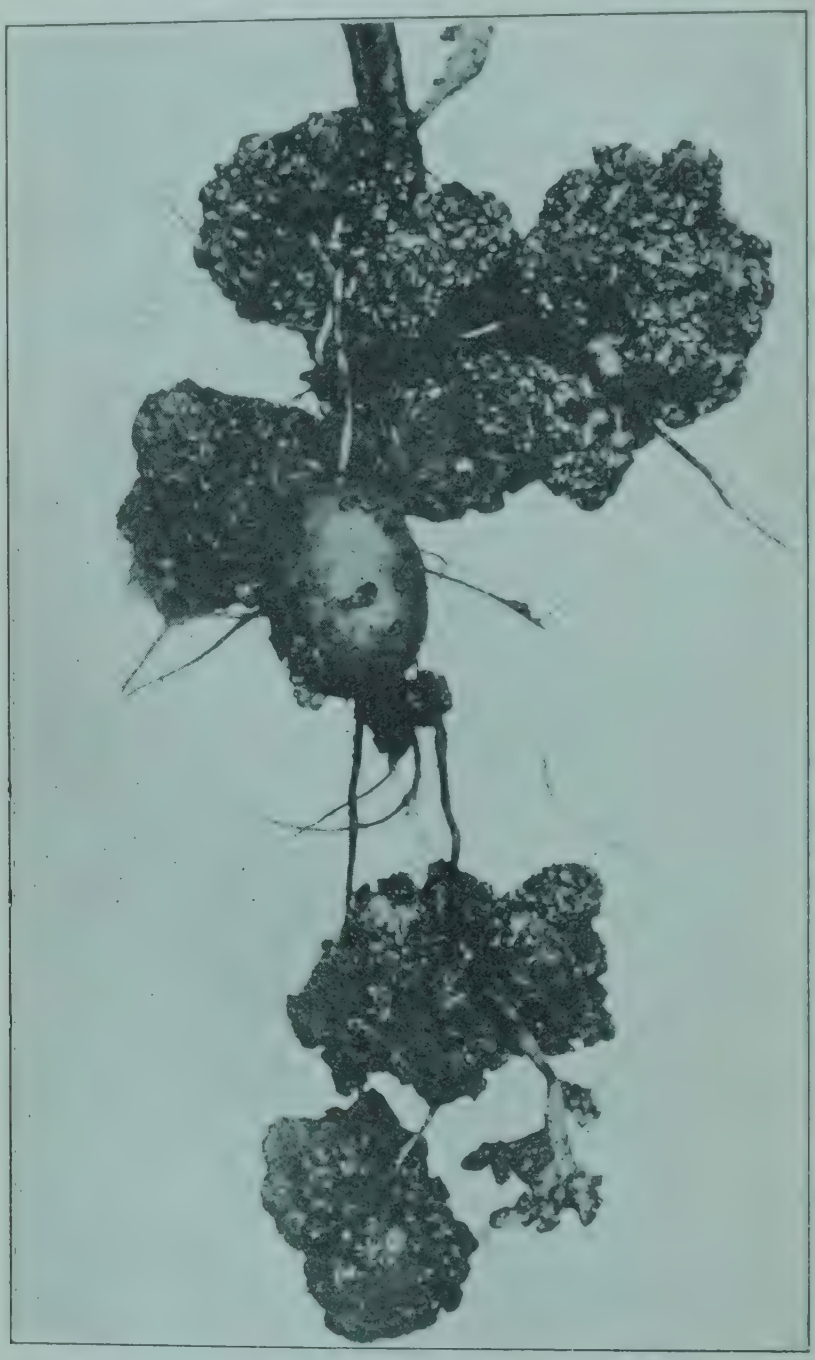

FIG. 220.—Potato wart. A plant as it appears when dug, showing a partially sound tuber covered with excresences caused by the fungus; also showing six malformed tubers. (After Güssow.)

221). These are green where they project from the ground and white below, turning as they grow old to dark brown or almost black. They have a wrinkled, coral-like appearance, much like the head of a cauli-

flower. A still more advanced stage occurs when the fungus has utilized every particle of food stored in the tuber and has reduced it to a brownish black soft mass, giving off a very unpleasant, putrefactive odor (Fig. 220). Such potatoes cannot be harvested whole. The black pulpy mass breaks up, liberating millions of sporangia (spore sacs) which live for years in the soil. The sporangia have been known to infest potato crops after an eight-year interval. So far as known, longer intervals have not been tested, and it is possible that the fungus may live in the soil even longer than that. This means that potatoes must not be planted again in the soil where the disease has been present for at least eight years, and possibly even longer.

Means of Distribution.

The chief means of distribution of the wart disease is through the use of apparently healthy or only slightly diseased seed coming from infected fields. Such seed entering an uninfected territory is the origin of a new center for distribution. The Harper Adams Agricultural College in a recent bulletin states a case of one consignment of such seed causing the spread of the disease over a district with a five-mile radius. Too much emphasis cannot be laid on the danger of planting seed taken from areas known to be infected. The danger would be lessened if tubers could be sorted into two lots—one diseased and one not diseased. It is practically impossible to do this, as slightly infected tubers cannot be detected even by the most rigid inspection. For this reason various countries have enacted laws prohibiting the importation of any potatoes from infected areas.

Control of the Wart Disease.

Extensive experiments have been conducted in England with various fungicides and variety tests of potatoes. There seems to be a consensus of opinion that fungicides are not efficacious in controlling the disease.

Better results are claimed to have been obtained by testing different varieties of potatoes. A number of varieties have been found to be resistant in England, but one authority maintains that "all the best varieties of potatoes, *i. e.*, all those most profitable to grow, are excluded as susceptible." He also states that one variety said to be immune is very susceptible to late blight. None of these varieties are of commercial importance in the United States.

At present crop rotation is the best method of dealing with the disease. Since the fungus has been known to live in the soil for eight years, potatoes should not be planted in infected soil during that period. Fortunately, so far as known, the fungus attacks no other crop.

In spite of the tariff of twenty-five cents a bushel, 8,383,966 bushels of potatoes came to our market from foreign countries in 1909. Great Britain, where the wart disease is most prevalent, exported in that year more than three times as many bushels into this country as all other

countries combined. These eight and one-third million bushels came to the following districts and states: Maine, Massachusetts, New York, Pennsylvania, Maryland, Virginia, Michigan, Arizona, Porto Rico, New Jersey, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Ohio, Wisconsin, Illinois, Minnesota, North Dakota, South Dakota, Missouri, Montana, Idaho, Washington, Oregon, California, Alaska, and Hawaii.

A vigorous effort should be made, if the potato wart should be found in the United States, to eradicate it immediately. All infected tubers should be boiled or burned and no more potatoes should be planted on that field for eight years. Stock should not be allowed to run over infected areas, and no part of any lot containing diseased potatoes should be used for seed purposes.

Until the passage of the national quarantine bill in August of this

FIG. 221.—Cross-sections of potatoes showing effects of the wart disease. (After Güssow.)

year governmental officials of the United States had no power or authority to keep diseased potatoes from being shipped into this country. With the passage of the law, full power is given to the Department of Agriculture, not only to prevent the introduction of diseased tubers, but also to quarantine foreign districts where the potato wart is known to occur. The law became effective immediately upon its passage, the clause being: "*Provided further*, that the quarantine provisions of this section, as applying to the white-pine blister rust, potato wart, and the Mediterranean fruit fly, shall become and be effective upon the passage of this act."

We are, therefore, afforded full protection at the hands of the Department of Agriculture, and we trust that it will not be slow to act in this most important matter.

SOME UNDESIRABLE IMMIGRANTS FROM JAPAN.

By B. B. Whitney.

The following list of insect pests were found upon nursery trees and ornamental plants arriving from Japan, and were taken by the writer in the performance of his duty in the State Horticultural Quarantine service at the port of San Francisco, during a period covering twelve months.

Fig. 222.—Coccidæ from Japan. 1, *Ceroplastes ceriferus* (Anderson); 2, Florida wax scale (*Ceroplastes floridensis* Comst.).

From the following list it will be plainly seen that the fruit growers and florists of California are not as yet afflicted with all the insect pests that trees and plants are heir to; in fact, it is true that they have but a small quota of the full compliment of the injurious insects of the world, and this immunity is not due by any means to the care exercised by the shippers, but in a large measure is the result of the diligent, patient work of the members of the Quarantine Division.

Apple trees. *Leucaspis japonica, Lepidosaphes ulmi, Parlatoria pergandii* and *Parlatoria proteus.*

Azaleas. *Pseudococcus azaleæ, Ceroplastes ceriferus, Pseudaonidia duplex, Pseudaonidia pæoniæ,* slug moth and pupæ of slug moth.

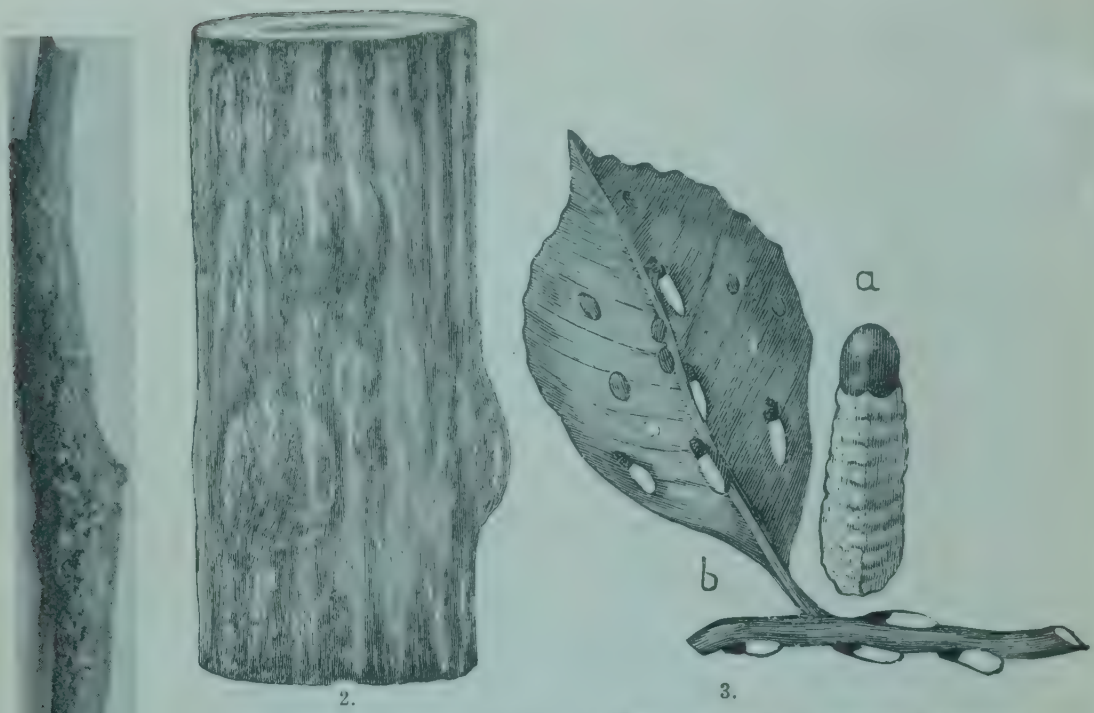

FIG. 223.—*Coccidæ* from Japan. 1, Mining scale (*Howardia biclavis* Comst.); 2, showing mining habits of *Howardia biclavis;* 3, *Pulvinaria camelicola* Sign.

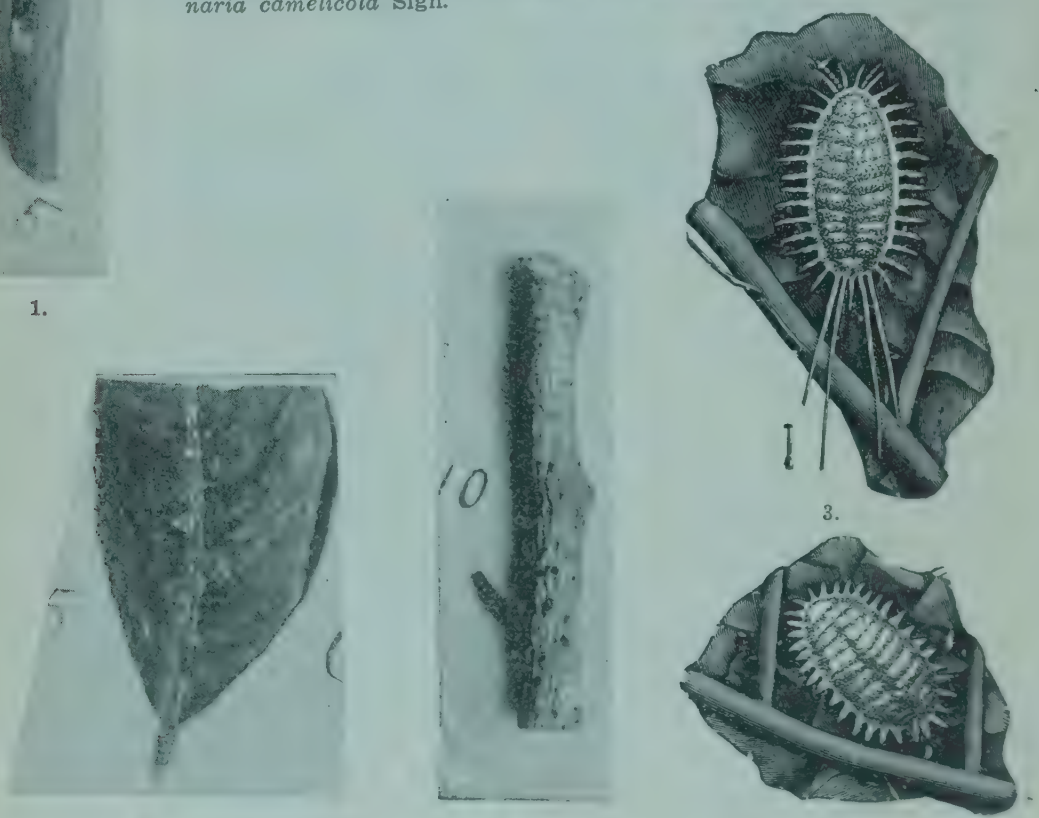

FIG. 224.—Coccidæ from Japan. 1, Chaff scale (*Parlatoria pergandii* Comst.); 2, *Parlatoria theæ* var. *viridis* Ckll.; 3, long-tailed mealy bug (*Pseudococcus adonidum* Linn.); 4, short-tailed or citrus mealy bug (*Pseudococcus citri* Risso.)

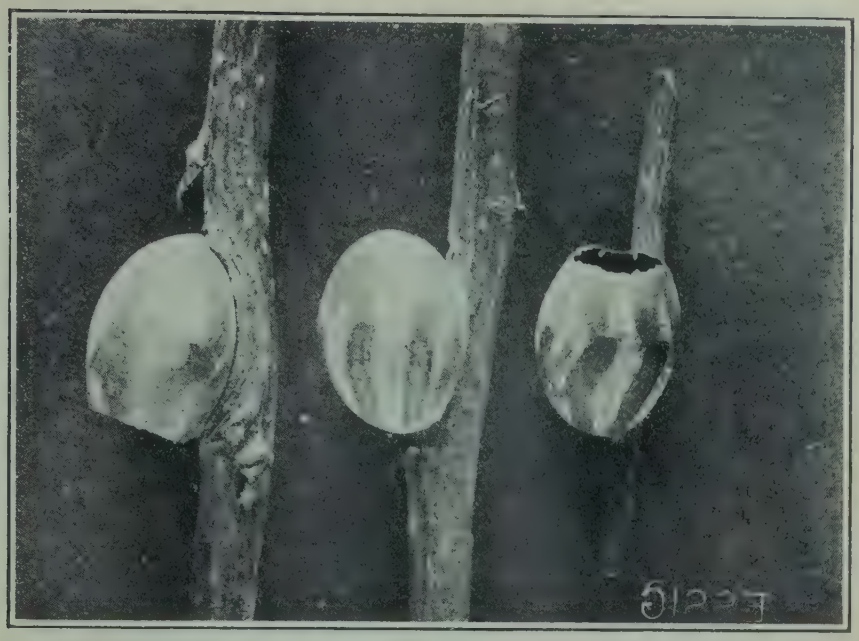

FIG. 225.—The pupæ cases of the slug moth from Japan.

Camellia. *Pulvinaria camelicola, Ceroplastes ceriferus, Chionaspis* sp., *Aspidiotus hederæ, Aspidiotus camelliæ, Pseudaonidia duplex, Chrysomphalus* sp., *Lepidosaphes lasianthi, Parlatoria pergandii, Parlatoria pergandii* var. *camelliæ* and a black pupæ of *Aleyrodes*, new species. This is a species described by Mr. Kuwana in manuscript. Mr. Kuwana has not, however, assigned a specific name to it. We have seen larvæ of this *Aleyrodes* at work on citrus leaves from Japan. Judging from what we have seen of this, it would prove a very bad pest upon citrus trees in California should it ever gain a foothold. Interested parties that have traveled through Japan say that this species should be called *Aleyrodes citri* in place of the *Aleyrodes* that is called *Aleyrodes citri* at the present time.

English Ivy. *Aleyrodes citri* and several species of scale insects.

Gardenias. *Ceroplastes floridensis* and *Aleyrodes citri.* There has been but one lot of Gardenias pass quarantine in the last eighteen months.

Ilex sp. *Pseudaonidia pæoniæ, Lepidosaphes ulmi, Paraltoria theæ* var. *viridis*, also two species of *Aleyrodes.*

Acer. sp. *Parlatoria pergandii* var. *camelliæ, Parlatoria theæ, Parlatoria theæ* var. *viridis, Parlatoria proteus*, slug moth pupæ, three species of slug moths, and in most cases the branches are black with the eggs of *Aphis* sp. Maple trees seldom ever pass quarantine.

Orange trees. *Pseudococcus citri, Pseudococcus adonidum, Pulvinaria aurantii* or *Pulvinaria psidii, Ceroplastes floridensis, Saissetia oleæ, Howardia biclavis, Aspidiotus* sp., *Chrysomphalus* sp., *Lepidosaphes* sp., *Parlatoria ziziphus* and *Aleyrodes citri*, also spiders, mites, slug moth, Mantis egg clusters, eggs of the Orange dog, and a fungi *Cladosporium citri.*

Pear trees. *Pseudococcus adonidum, Leucaspis japonica, Parlatoria proteus*, also eggs of *Cicada* sp., Mantis egg clusters and slug moth pupæ on the branches.

Peach trees. *Aulacaspis pentagona*, slug moth pupæ and Mantis egg clusters. Peach trees seldom ever pass.

Plum trees. *Pseudococcus adonidum, Aulacaspis pentagona*, slug moth pupæ and Mantis egg clusters. Plum trees seldom ever pass.

Prune trees. *Aulacaspis pentagona*, slug moth pupæ and Mantis egg clusters. Prune trees seldom ever pass.

It will be noticed that the foregoing were found upon trees and plants only coming from Japan; however, they may be taken as a fair index of the condition of such material arriving from other parts of the world; while species may differ, the genera are fairly representative. With fruits, vegetables and tubers, the list of insects is different in character and of less extent, but nevertheless of much economic importance.

HOST INDEX TO CALIFORNIA COCCIDÆ.

By C. F. Baker and E. O. Essig.

The first host index was published in the Pomona Journal of Entomology, Vol. 1, No. 2, June, 1910. It was roughly compiled from all the publications which we happened to have at hand and was then submitted for correction and emendation to Mr. Edw. M. Ehrhorn, Mr. R. S. Woglum, Mr. E. K. Carnes, Prof. T. D. A. Cockerell, and Mr. E. R. Sasscer. The index was completely remodeled in accordance with their notes. Since that time we have been constantly at work adding to this index, which we hope, in time, to make complete.

So far as possible the names of those (other than the authors) reporting the host plant will follow the coccid, and all scientific changes of coccid names which are compelled by priority rules will be followed. As was before stated, *Aspidiotus camelliæ* instead of *Aspidiotus rapax*, *Dactylopius coccus* in place of *Coccus cacti* and *Pulvinaria vitis* in place of *Pulvinaria innumerabilis*. To these changes we now add the following: *Pseudococcus longispinus* to *Pseudococcus adonidum*, *Phenacoccus ramonæ* to *Ceroputo yuccæ*, *Lecanium magoliarum* and *Eulecanium persicæ* to *Lecanium persicæ*, *Eulecanium pruinosum* to *Lecanium pruinosum*, *Eulecanium* and *Lecanium adenostomæ*, *Eulecanium armeniacum* to *Lecanium corni* and *Diaspis pentagona* to *Aulacaspis pentagona*.

Abies sp.? (Fir).
Chionaspis pinifoliæ.

Abies bracteata.
Chionaspis pinifoliæ—Lindinger.

Abies concolor (White Fir).
Aspidiotus ehrhorni.
Leucaspis kelloggi.
Physokermes concolor.

Abies grandis.
Leucaspis kelloggi.

Abies magnifica (Red Fir).
Leucaspis kelloggi.

Abies shastensis.
Leucaspis kelloggi.

Acacia sp.?
Aspidiotus camelliæ—Woglum.
Aspidiotus hederæ.
Chrysomphalus aurantii—Woglum.
Diaspis boisduvalii. Only in quarantine—Carnes.
Icerya purchasi.
Saissetia oleæ.

Acacia melanoxylon (Australian Blackwood).
Aspidiotus hederæ.
Aspidiotus camelliæ.

Acer sp.? (Maple).
Aspidiotus hederæ.
Chrysomphalus tenebricosus.
Leucaspis japonica.
Pulvinaria vitis.

Acer macrophyllum (Large-leaved Maple).
Eulecanium crawii.

Adenostoma fasciculatum (Chamiso).
Eriococcus adenostomæ—Ehrhorn.
Lecanium corni.
Lecaniodiaspis rufescens.
Tachardia sp.—Woglum.
Xerophilaspis prosopidis—Woglum.

Adiantum pedatum (Maiden-hair Fern).
Aspidiotus hederæ—Woglum.
Saissetia hemisphærica. Only in greenhouses—Ehrhorn.

Æsculus californica (Buckeye—Horsechestnut).
Aspidiotus æsculi.

Agathis—see Dammaria.

Agave sp.? (Century Plant).
Chrysomphalus aurantii.

Alder—see Alnus.

Almond—see Prunus amygdalus.

Alnus sp.? (Alder).
Pulvinaria ehrhorni.

Alnus japonica.
Chionaspis wistariæ. Only at quarantine—Ehrhorn.

Amaranthus retroflexus (Pig Weed).
Pseudococcus solani.

Ananassa sativa (Pineapple).
Diaspis bromeliæ. In greenhouses and at quarantine.—Ehrhorn.

Andropogon furcatus.
Aclerda californica.

Anemone sp.?
Pseudococcus affinis——U. S. Dept. Agrcl.

Apple—see Pyrus malus.

Apricot—see Prunus armeniaca.

Aralia sieboldi.
Coccus hesperidum—Ehrhorn.
Saissetia hemisphærica—Ehrhorn.
Saissetia oleæ.

Araucaria bidwelli.
Chrysomphalus rossi—Woglum.
Chrysomphalus aonidum. Only in greenhouses—Ehrhorn.
Eriococcus araucariæ—U. S. Dept. Agrcl.
Pseudococcus aurilanatus.

Araucaria excelsa.
Eriococcus araucariæ—Woglum.
Pseudococcus aurilanatus—Bishop.

Araucaria imbricata.
Chrysomphalus rosii—U. S. Dept. Agrcl.
Eriococcus araucariæ—U. S. Dept. Agrcl.

Arbor-vitæ—see Thuya.

Arctostaphylos viscida.
Aspidiotus abietis—U. S. Dept. Agrcl.

Areca catechu (Betel Nut).
Saissetia hemisphærica Only in greenhouses—Ehrhorn.

Artemisia californica (California Sage).
Ceroplastes irregularis—Smith.
Eriococcus artemisiæ.
Erium lichtensioides.
Orthezia artemesiæ—Bishop.
Phenacoccus artemesiæ—Ehrhorn.
Pseudococcus artemesiæ.
Pseudococcus crawii.
Pseudococcus hymenocleæ—U. S. Dept. Agrcl.
Saissetia oleæ.

Ash—see Fraxinus.

Asparagus plumosus (Climbing Asparagus).
Aspidiotus hederæ.

Asparagus sprengerii.
Aspidiotus hederæ—Ehrhorn.

Aspidistra lurida.
Chrysomphalus aonidum—U. S. Dept. Agrcl.
Hemichionaspis aspidistræ. Only at quarantine and in greenhouses—Ehrhorn.

Aster sp.
Pseudococcus solani.
Saissetia oleæ.

Atriplex sp.?
Phenacoccus simplex.

Atriplex canescens.
Ceroplastes irregularis—Ehrhorn.

Atriplex confertifolia.
Ceroplastes irregularis—Ehrhorn.

Aucuba sp.?
Phenacaspis chinensis. Only at quarantine—Ehrhorn.

Australian Blackwood—see Acacia melanoxylon.

Azalea sp.?
Pseudococcus azaleæ. Only at quarantine—Ehrhorn. In greenhouses.

Baccharis pilularis.
Aspidiotus camelliæ—U. S. Dept. Agrcl.

Baccharis viminalis.
Saissetia oleæ.

Bahia sp.?
Ceroputo bahiæ.
Targionia dearnessi—U. S. Dept. Agrcl.

Bambusa sp.? (Bamboo).
Antonina crawii. Only at quarantine—Ehrhorn.
Aclerda tokionis. Only at quarantine—Ehrhorn.
Odonaspis bambusarum. Only at quarantine—Ehrhorn.

Bay Tree—California—see Umbellularia californica.

Beet—see Beta.

Beta sp.? (Beet).
Saissetia oleæ.

Begonia sp.?
Pseudococcus citri. Only in greenhouses.

Begonia, Rex.
Pseudococcus adonidum. Only in greenhouses.
Pseudococcus citri. Only in greenhouses.

Begonia, Tree.
Coccus hesperidum.

Betula sp.? (Birch).
Lecanium pruinosum—Coquillett.

Bigelovia sp.?
Pulvinaria bigeloviæ.

Bigelovia brachylepis.
Targionia bigeloviæ.

Bignonia sp.?
Ceroplastes cistudiformis.
Pseudococcus citri.
Saissetia hemisphærica.

Birch—see Betula.

Black Sage—see Ramona stachyoides.

Blackberry—see Rubus nigrobaccus.

Blackwood—see Acacia melanoxylon.

Boston Fern—see Nephrolepis exaltata.

Bottle Brush—see Callistemon.

Bouvardia sp.?
Pseudococcus citri. Only in greenhouses.

Boxwood—see Buxus.

Brunfelsia sp.?
Eucalymnatus perforatus. Only in greenhouses—Ehrhorn.

Bryophyllum calycinum (Ghost Plant).
Saissetia hemisphærica.

Buckeye—see Æsculus.

Buckwheat, Wild—see Eriogonium fasciculatum.

Buxus sp.? (Boxwood).
Aspidiotus hederæ—Woglum.
Saissetia hemisphærica—Woglum.
Saissetia oleæ—Woglum.

Cacti (genera? species?)—see, also, Opuntia, Cereus, etc.
Dactylopius coccus—U. S. Dept. Agrcl.
Diaspis cacti—Ehrhorn.
Diaspis echinocacti—Ehrhorn.

Cajaput tree—Melaleuca leucadendron.

Calla Lily—see Richardia africana.

California Laurel or Bay Tree—see Umbellularia californica.

Callistemon lanceolatus (Bottle brush).
Pseudococcus citri.

Camellia japonica.
Aspidiotus camelliæ.
Aspidiotus hederæ.
Ceroplastes ceriferus. Only at quarantine—Ehrhorn.
Chrysomphalus aonidum. Only in greenhouses—Ehrhorn.
Coccus hesperidum.
Fiorina fiorinæ. Only in greenhouses—Ehrhorn.
Parlatoria pergandii—U. S. Dept. Agrcl.

Camellia japonica—Continued.
Pseudaonidia duplex. Only at quarantine—Ehrhorn.
In greenhouses—Carnes.
Pseudaonidia pæoniæ. Only at quarantine—Ehrhorn.
Pulvinaria camelicola—Woglum.
Saissetia hemisphærica.

Camphora officinalis (Camphor tree).
Aspidiotus camelliæ.
Chrysomphalus aurantii—Woglum.
Pseudaonidia duplex. Only at quarantine—Ehrhorn.

Carex breweri (Sedge).
Exæretopus caricis—U. S. Dept. Agrcl.

Castor Bean—see Ricinus communis.

Cattleya sp.?
Diaspis boisduvalii.
Diaspis cattleyæ. These two scales only at quarantine and in greenhouses—Ehrhorn.

Ceanothus sp.?
Chionaspis salicis-nigræ.

Ceanothus cuneatus.
Ceroputo yuccæ.
Aspidiotus camelliæ.

Ceanothus rigidus.
Mytilaspis concolor—U. S. Dept. Agrcl.

Ceanothus integerrimus.
Pseudococcus citri.
Saissetia hemisphærica.

Ceneraria sp.?
Pseudococcus adonidum—Greenhouses.

Century Plant—see Agave.

Cereus sp.?
Pseudococcus adonidum.

Cercis sp.?
Aspidiotus camelliæ—U. S. Dept. Agrcl.

Chamiso—see Adenostoma fasciculatum.

Chenopodium sp.?
Eriococcus neglectus—U. S. Dept. Agrcl.

Cherry—see Prunus cerasus.

Christmas Cactus—see Epiphyllum.

Chrysanthemum sp.?
Orthezia insignis.

Cissus sp.?
Aspidiotus camelliæ—U. S. Dept. Agrcl.

Citrullus vulgaris (Watermelon).
Pseudococcus citri.
Saissetia oleæ.

Citrus aurantium (Orange).
Aspidiotus camelliæ.
Aspidiotus hederæ.
Ceroplastes ceriferus. Only at quarantine—Ehrhorn.
Ceroplastes cirripediformis. Only at quarantine—Ehrhorn.
Ceroplastes rubens. Only at quarantine—Ehrhorn.
Chrysomphalus aonidum. Only at quarantine—Ehrhorn.
Chrysomphalus aurantii.
Chrysomphalus citrinus.
Coccus hesperidum.
Lecanium pruinosum—U. S. Dept. Agrcl.
Hemichionaspis aspidistræ. Only at quarantine—Ehrhorn.
Howardia biclavis. Only at quarantine—Ehrhorn.
Icerya purchasi.
Lepidosaphes beckii.
Lepidosaphes gloverii.
Parlatoria pergandii.
Pseudococcus citri.
Pseudococcus adonidum.
Saissetia hemisphærica.
Saissetia oleæ.

Citrus decumana (Forbidden Fruit, Fruit of Paradise, Pomelo, Grape Fruit).
Same list as for Citrus aurantium.

Citrus medica (Citron).
Same list as for Citrus aurantium.

Citrus limonum (Lemon).
Same list as for Citrus aurantium.

Citrus trifoliata.
Aspidiotus perniciosus var. andromelas.

Clianthus sp.?
Coccus hesperidum—U. S. Dept. Agrcl.

Coachwhip—see Fouquieria splendens.

Cochineal cactus—see Nopalea cochinellifera.

Coconut palm—see Cocos nucifera.

Cocos nucifera (Coconut Palm).
Pseudococcus pseudonipæ—Woglum.
Saissetia hemispharica. Only at quarantine—Ehrhorn.

Cocos plumosa.
Hemichionaspis aspidistræ. Rare in greenhouses—Ehrhorn.

Coelogyne cristate.
Aspidiotus dictyospermi—U. S. Dept. Agrcl.

Coleus sp.?
Pseudococcus citri—Ehrhorn.
Pseudococcus adonidum.
Orthezia insignis. Greenhouses.

Cornus sp.?
Chionaspis linterni—Culbertson.
Chionaspis salicis-nigræ—U. S. Dept. Agrcl.
Lepidosaphes ulmi—U. S. Dept. Agrcl.

Crane's-bill—see Geranium.

Crataegus sp.? (Thornapple, Hawthorn).
Aspidiotus perniciosus.

Cucurbita pepo (Pumpkin).
Pseudococcus citri.

Cupressus goveniana.
Leucaspis cupressi.
Pseudococcus andersoni.

Cupressus macnabiana.
Aspidiotus coniferarum shastæ.
Pseudococcus dudleyi.

Cupressus macrocarpa (Monterey Cypress).
Chionaspis striata—U. S. Dept. Agrcl.
Pseudococcus cupressi.
Pseudococcus ryani.
Xylococcus macrocarpæ.

Currant—see Ribes.

Cycas revoluta (Sago Palm).
Coccus hesperidum. Only in greenhouses—Ehrhorn.
Fiorina fiorinæ. Only in greenhouses—Ehrhorn.
Pseudococcus adonidum. Only in greenhouses—Ehrhorn.
Saissetia oleæ.

Cydonia vulgaris (Quince).
Aspidiotus camelliæ.
Aspidiotus perniciosus.
Sassetia oleæ.

Cydonia japonica (Japanese Quince).
Aspidiotus camelliæ.
Aspidiotus perniciosus.
Pseudococcus bakeri.

Cyperus alternifolius.
Aspidiotus hederæ. Only in greenhouses—Ehrhorn.
Pseudococcus citri. Only in greenhouses—Ehrhorn.
Pseudococcus adonidum. Only in greenhouses—Ehrhorn.

Cypress—see Cupressus.

Dammaria ovata.
Pseudococcus aurilanatus. Only in quarantine—Ehrhorn.

Dammaria vitiensis.
Pseudococcus aurilanatus. Only in greenhouses—Ehrhorn.

Dioscorea sp?.
Aspidiotus camelliæ—Woglum.

Diospyros kaki (Japanese Persimmon).
Aulacaspis pentagona. Only at quarantine—Ehrhorn.

Diplacus glutinosus (Monkey Flower).
Ceroputo yuccæ.

Distichlis maritima (Marsh spike grass).
Sphærococcus distichlium.

Dracaena sp.?
Aulacaspis crawii. Only in quarantine—Ehrhorn.
Chrysomphalus aonidum—Crawford.
Pseudococcus adonidum.
Saissetia oleæ.

Elaegnus sp.
Chionaspis difficilis. Only at quarantine—Ehrhorn.
Lepidosaphes beckii. Only at quarantine—Ehrhorn.

Elaeagnus umbellata.
Aulacaspis crawii. Only at quarantine—Ehrhorn.

Elder—see Sambucus.

Elm—see Ulmus.

Elymus condensatus.
Ripersia smithii.

English Laurel—see Prunus lauro-cerasus.

Ephedra umbellata.
Aulacaspis crawii—Only in quarantine—Ehrhorn.

Epiphyllum sp.? (Lobster or Christmas Cactus).
Pseudococcus adonidum. In greenhouses

Erica sp.?
Aspidiotus camelliæ.

Eriogonum sp.?
Erium eriogoni.

Eriogonum fasciculatum (Wild Buckwheat).
Eriococcus palmeri. Recorded also from Lower California on Boureria sonoræ—Ehrhorn.
Ceroputo yuccæ—Pease.

Eriogonum latifolium.
Pseudococcus maritimus.

Erythea edulis (Guadalupe Island Palm).
Pseudococcus adonidum.
Pseudococcus citri.

Eucalyptus sp.?
Aspidiotus camelliæ.
Aspidiotus hederæ—U. S. Dept. Agrcl.
Phenacaspis latissima. Only at quarantine—Ehrhorn.
Saissetia oleæ.

Euonymus japonicus.
Aspidiotus camelliæ.
Aspidiotus hederæ—Lindinger.
Chionaspis euonymi. In nursery houses—Ehrhorn.
Chrysomphalus aurantii.
Saissetia oleæ.

Euonymus latifolius.
Chionaspis euonymi. Only at quarantine—Ehrhorn.

Euphorbia pulcherrima (Poinsettia).
Chrysomphalus aurantii.
Pseudococcus citri.
Saissetia hemisphærica.
Saissetia oleæ.

Ferns—see Filicales.

Fescue—see Festuca scabrella.

Festuca scabrella.
Ripersia festucæ.

Ficus carica (Fig).
Aspidiotus camelliæ.
Chrysomphalus aurantii.
Chrysomphalus citrinus.
Coccus hesperidum.

Fig—see Ficus carica.

Filicales (Ferns).
Ceroplastes rubens. Only at quarantine—Ehrhorn.
Hemichionaspis aspidistræ. Only at quarantine—Ehrhorn.
Pinnaspis buxi. Only at quarantine—Ehrhorn.
Pseudococcus citri. In greenhouses—Ehrhorn.

Filicales (Ferns)—Continued.
Pseudococcus adonidum. In greenhouses—Ehrhorn.
Pulvinaria psidii. Only at quarantine—Ehrhorn.
Saissetia hemisphærica. In greenhouses—Ehrhorn.
Saissetia oleæ. In greenhouses—Ehrhorn.

Fir—see Abies.

Forbidden Fruit—see Citrus decumana.

Fouquieria splendens (Ocotillo, Coach-whip, Vine Cactus, Jacob's Staff.)
Lecaniodiaspis rufescens.

Fragaria chilensis (Wild Strawberry).
Aulacaspis rosæ.

Fuchsia sp.?
Aspidiotus camelliæ.
Pseudococcus adonidum.
Pseudococcus citri.

Fraxinus sp.? (Ash).
Lecanium pruinosum—Coquillett.

Gardenia sp.? (Jasmine).
Ceroplastes ceriferus. Only at quarantine—Ehrhorn.
Coccus hesperidum.

Genista alba.
Aspidiotus camelliæ—U. S. Dept. Agrcl.

Geranium sp.? (Crane's-bill).
Icerya purchasi.
Pseudococcus citri. In greenhouses—Ehrhorn.
Coccus hesperidum.
Saissetia hemisphærica.
Saissetia oleæ.

Ghost Plant—see Bryophyllum calycinum.

Gleditschia sp.?
Aspidiotus camelliæ—U. S. Dept. Agrcl.

Golden Rod—see Solidago.

Gramineae, genera? species? (Grass).
Odonaspis graminis—Ehrhorn.
Pseudococcus salinus.
Ripersiella kelloggi.

Grape—see Vitis.

Grape-fruit—see Citrus decumana.

Grass—see Gramineæ, Festuca, Distichlis and Spartina.

Guadalupe Island Palm—see Erythea edulis.

Gum-tree—see Eucalyptus.

Hawthorn—see Cratægus.

Hedera helix (English Ivy).
Aspidiotus camelliæ—U. S. Dept. Agrcl.
Aspidiotus hederæ.
Coccus hesperidum.
Fiorina fiorinæ. Only at quarantine—Ehrhorn.
Saissetia oleæ.

Heteromeles arbutifolia (Mountain Holly).
Aspidiotus camelliæ—Lindinger.
Coccus hêsperidum—U. S. Dept. Agrcl.
Saissetia oleæ.

Hibiscus sp.?
Aulacaspis pentagona. Only in quarantine—Ehrhorn.
Ceroplastes ceriferus. Only in quarantine—Ehrhorn.
Saissetia oleæ.

Incense Cedar—see Libocedrus decurrens.

Ipoemoea bona-nox (Moon Flower).
Orthezia insignis.
Pseudococcus adonidum—Beers.

Ivy—see Hedera helix.

Jacob's Staff—see Fouquieria splendens.

Japanese Flowering Quince—see Cydonia japonica.

Japanese Rattan Palm—see Rhapis flobeliformis.

Jasmine—see Gardenia.

Judas Tree—see Cercis.

Juglans regia (Walnut).
Aspidiotus camelliæ—U. S. Dept. Agrcl.
Aspidiotus juglans-regiæ.
Aspidiotus perniciosus.
Chrysomphalus aurantii-Prizer—Bishop.
Eulecanium cerasorum—Woglum.
Lecanium pruinosum—Coquillett.
Pseudococcus bakeri.

Juniperus sp.?
Diaspis carueli.

Kentia sp.?
Aspidiotus dictospermi—U. S. Dept. Agrcl.

Kentia belucoria.
Eucalymnatus perforatus. In greenhouses.

Lantana sp.?
Orthezia insignis—Woglum.

Larrea sp.?
Tachardia larreæ—U. S. Dept. Agrcl.

Latania borbonica (Fan Palm).
Aspidiotus hederæ.

Laurus nobilis (Sweet Bay Tree).
Coccus hesperidum—Ehrhorn.
Eucalymnatus perforatus.
Saissetia oleæ—U. S. Dept. Agrcl.

Lavatera assurgentifolia.
Aspidiotus camelliæ—U. S. Dept. Agrcl.

Lemon—see Citrus limonum.

Leucadendron argenteum (Silver Tree).
Saissetia oleæ.

Libocedrus decurrens (Incense Cedar).
Aspidiotus ehrhorni.
Pseudococcus andersoni.

Ligustrum ovalifolium (Privet).
Saissetia oleæ.

Ligustrum vulgare (Privet).
Aspidiotus perniciosus.

Lobster Cactus—see Epiphyllum.

Magnolia sp.?
Aspidiotus hederæ.
Lecanium persicæ—Cockerell.
Lepidosaphes gloverii.
Leucaspis japonica.

Maiden hair Fern—see Adiantum pedatum.

Malva rotundifolia (Malva).
Pseudococcus solani.

Maple—see Acer.

Marsh Mallow—see Hibiscus.

Mazzard—see Prunus avium.

Melaleuca leucadendron (Cajaput Tree. Paper-bark Tree).
Saissetia oleæ.

Melia azedarach (Umbrella Tree).
Aspidiotus camelliæ—Ehrhorn.
Aspidiotus hederæ.
Coccus hesperidum.

Mesembryanthemum sp.?
Ceroputo yuccæ—Whitney.

Mistletoe—see Phoradendron flavescens.

Monkey Flower—see Diplacus glutinosus.

Monterey Cypress—see Cupressus macrocarpa.

Moon Flower—see Ipæmœa bona-nox.

Morus sp.? (Mulberry).
Aspidiotus hederæ.
Chrysomphalus aurantii—Woglum.

Mulberry—see Morus.

Myrtus sp.? (Myrtle).
Aspidiotus camelliæ—Ehrhorn.
Coccus hesperidum.
Saissetia oleæ.

Nerium oleander (Oleander).
Aspidiotus hederæ.
Chrysomphalus aurantii.
Coccus hesperidum.
Pseudococcus citri.
Pseudococcus adonidum.
Saissetia hemisphærica.
Saissetia oleæ.

Nephrolepis exaltata (Boston Fern).
Pinnaspis buxi. Only at quarantine—Ehrhorn.
Saissetia hemisphærica. In greenhouses—Ehrhorn.

Nettle—see Urtica.

Nightshade—see Solanum douglasii.

Nopalea cochinellifera (Cochineal Cactus).
Dactylopius coccus.

Norfolk Pine—see Araucaria.

Oak—see Quercus.

Octillo—see Fouquieria splendens.

Odontoglossum sp.?
Aulacaspis boisduvalli—U. S. Dept. Agrcl.
Aulacaspis miranda—U. S. Dept. Agrcl.

Olea fragrans (Olive).
Aspidiotus camelliæ.
Aspidiotus hederæ.
Chrysomphalus aurantii.
Pollinia pollini. Appeared in Los Angeles County, but was eradicated—Carnes.

Olea fragrans (Olive)—Continued.
Pseudaonidia duplex. Only at quarantine—Ehrhorn.
Saissetia oleæ.

Oleander—see Nerium oleander.

Olive—see Olea.

Opuntia sp.?
Pseudococcus obscurus.
Pseudococcus adonidum.

Opuntia littoralis.
Aspidiotus hederæ—U. S. Dept. Agrcl.

Orange—see Citrus aurantium.

Orchids—see Cœlogyne, Cattleya, Odontoglossum.

Osage Orange—see Toxylon pomiferum.

Paeonia sp.? (Peony).
Leucaspis japonica. Only at quarantine—Ehrhorn.
Pseudaonidia pæoniæ. Only at quarantine—Ehrhorn.
Pseudococcus citri. In greenhouses—Ehrhorn.

Palma Cristi—see Ricinus communis.

Palmae genera? species? (Palms).
Aspidiotus hederæ.
Phenacaspis cockerelli. Only at quarantine—Ehrhorn.
Phenacaspis latissima. Only at quarantine—Ehrhorn.

Palms—see Cocos, Kentia, Latania, Phœnix.

Paper-bark Tree—see Melaleuca leucadendron.

Passion Vine—see Passiflora.

Passiflora sp.?
Aspidiotus camelliæ. Greenhouses.
Pseudococcus citri. In greenhouses.

Peach—see Prunus persica.

Pear—see Pyrus communis.

Pepper Tree—see Schinus molle.

Persimmon—see Diospyros kaki.

Phlox sp.?
Saissetia oleæ.

Phoenix dactylifera.
Aspidiotus hederæ.
Chrysomphalus aurantii.
Parlatoria victrix—U. S. Dept. Agrcl.
Phenacoccus marlatti—U. S. Dept. Agrcl.

Phoradendron flavescens (Mistletoe).
Aspidiotus camelliæ—U. S. Dept. Agrcl.
Aspidiotus hederæ.
Saissetia oleæ—U. S. Dept. Agrcl.

Phormium tenax.
Pseudococcus calceolariæ.

Picea sp.? (Spruce).
Chionaspis pinifoliæ.

Picea breweriana.
Phenacoccus kuwanæ.

Pig Weed—see Amaranthus retroflexus.

Pine—see Pinus.

Pineapple—see Ananassa sativa.

Pinus sp.? (Pine).
Chionaspis pinifoliæ.

Pinus attenuata.
Aspidiotus californicus.

Pinus attenuata tuberculata.
Aspidiotus abietis—U. S. Dept. Agrcl.

Pinus coulteri.
Aspidiotus abietis—U. S. Dept. Agrcl.

Pinus insignis.
Aspidiotus hederæ—U. S. Dept. Agrcl.
Chionaspis pinifoliæ—U. S. Dept. Agrcl.
Coccus hesperidum—U. S. Dept. Agrcl.
Physokermes insignicola.

Pinus lambertiana (Sugar Pine).
Aspidiotus abietis—U. S. Dept. Agrcl.
Aspidiotus californicus.
Chionaspis pinifoliæ—Lindinger.

Pinus ponderosa (Bull Pine).
Aspidiotus abietis—U. S. Dept. Agrcl.
Aspidiotus californicus.
Aspidiotus coniferarum.
Aspidiotus florenciæ.

Pinus radiata (Monterey Pine).
Chionaspis pinifoliæ—U. S. Dept. Agrcl.

Pinus sabiniana.
Aspidiotus californicus.
Chionaspis pinifoliæ—U. S. Dept. Agrcl.

Pinus torreyana.
Chionaspis pinifoliæ—Lindinger.

Pittosporum undulatum.
Aspidiotus rapax.
Icerya purchasi.
Saissetia oleæ.

Platanus racemosa (Sycamore).
Aspidiotus juglans-regiæ.
Lecanium pruinosum.

Platycerium sp.? (Staghorn Fern).
Coccus hesperidum. In greenhouses—Ehrhorn.
Hemichionaspis aspidistræ. In greenhouses—Ehrhorn.
Pseudococcus adonidum. In greenhouses—Ehrhorn.

Platycerium sp.? (Staghorn Fern).
Coccus hesperidum. In greenhouses—Ehrhorn.
Hemichionaspis aspidistræ. In greenhouses—Ehrhorn.
Pseudococcus adonidum. In greenhouses—Ehrhorn.

Pluchea sp.?
Pulvinaria plucheæ—U. S. Dept. Agrcl.

Plum—see Prunus domestica.

Plumbago sp.?
Pseudococcus citri—U. S. Dept. Agrcl.

Poinsettia—see Euphorbia pulcherrima.

Pomegranate—see Punica granatum.

Pomelo—see Citrus decumana.

Populus sp.? (Poplar, Aspen).
Aspidiotus perniciosus.
Chionaspis ortholobis.
Chionaspis salicis-nigræ.

Populus deltoides (Cottonwood).
Aspidiotus camelliæ.
Chionaspis ortholobis.

Populus tremuloides (Aspen).
Aspidiotus ancylus—U. S. Dept. Agrcl.

Potato—see Solanum tuberosum.

Portulace oleracea (Purslane).
Pseudococcus solani—Vary.

Primula obconica.
Pseudococcus adonidum. In greenhouses.

Privet—see Ligustrum.

Prune—see Prunus domestica var. galatensis.

Prunus amygdalus (Almond).
Aspidiotus camelliæ.
Aspidiotus juglans-regiæ.
Aspidiotus perniciosus.

Prunus armeniaca (Apricot).
Lecanium corni.
Lecanium pruinosum.
Saissetia oleæ.

Prunus cerasus (Cherry).
Aspidiotus camelliæ—Ehrhorn.
Aspidiotus juglans-regiæ.
Aspidiotus perniciosus—Ehrhorn.
Lecanium corni.
Lecanium pruinosum.

Prunus domestica (Plum).
Aspidiotus hederæ.
Aspidiotus juglans-regiæ.
Aspidiotus perniciosus.
Chrysomphalus aurantii.
Epidiaspis piricola.
Eulecanium pruinosum.
Lecanium corni.
Lepidosaphes ulmi.
Pseudococcus adonidum.
Pulvinaria amygdali—U. S. Dept. Agrcl.
Saissetia oleæ.

Prunus lauro-cerasus (English Laurel).
Lecanium pruinosum—Coquillett.

Prunus domestica var. galatensis (Prune).
Aspidiotus juglans-regiæ—U. S. Dept. Agrcl.
Aspidiotus perniciosus.
Aulacaspis pentagona—U. S. Dept. Agrcl.
Lecanium corni.
Lecanium persicæ—U. S. Dept. Agrcl.
Lecanium pruinosum.
Saissetia oleæ—Ehrhorn.

Prunus persica (Peach).
Aspidiotus juglans-regiæ—U. S. Dept. Agrcl.
Aspidiotus perniciosus.
Aulacaspis pentagona—U. S. Dept. Agrcl.
Lecanium persicæ—U. S. Dept. Agrcl.
Lecanium pruinosum.
Epidiaspis piricola.
Saissetia hemisphærica.
Saissetia oleæ.

Prunus triflora (Japanese Plum).
Aspidiotus perniciosus.

Pseudotsuga taxifolia (False Tsuga).
Aspidiotus abietis—U. S. Dept. Agrcl.
Leucaspis kelloggi.
Physokermes taxifolia.

Pumpkin—see Cucurbita pepo.

Punica granatum (Pomegranate).
Aspidiotus camelliæ—Ehrhorn.
Aspidiotus hederæ—Ehrhorn.
Saissetia oleæ.

Purslane—see Portulaca oleraceæ.

Pyrethrum roseum.
Saissetia oleæ.

Pyrus communis (Pear).
Aspidiotus camelliæ.
Aspidiotus juglans-regiæ.
Aspidiotus perniciosus.
Aulacaspis rosæ.
Epidiaspis piricola.
Lecanium corni.
Eulecanium cerasorum.
Lecanium pruinosum—Coquillett.
Lepidosaphes ulmi.
Pseudococcus bakeri.
Pulvinaria vitis.
Saissetia oleæ.

Pyrus malus (Apple).
Aspidiotus camelliæ.
Aspidiotus juglans-regiæ.
Aspidiotus perniciosus.
Chionaspis furfurus—U. S. Dept. Agrcl.
Chrysomphalus aurantii.
Chrysomphalus tenebricosus.
Epidiaspis piricola.
Lecanium corni.
Lecanium pruinosum—Coquillett.
Lepidosaphes ulmi—U. S. Dept. Agrcl.
Pseudococcus bakeri.
Saissetia oleæ.

Pyrus sinensis (Sand Pear, Chinese Pear).
Aspidiotus perniciosus.

Quercus sp.?
Aspidiotus densifloræ.
Aspidiotus hederæ.
Aspidiotus yulupæ.
Cerococcus quercus.
Chionaspis quercus.
Eriococcus quercus—Whitney.
Eulecanium pubescens.
Eulecanium quercitronis var. kermoides.
Kermes cockerelli—Branigan.
Kermes kelloggi—Whitney.
Kermes nigropunctatus.
Kermes shastensis.
Pseudococcus quercus.

Quercus agrifolia.
Cerococcus ehrhorni.
Cerococcus quercus.
Chionaspis quercus—U. S. Dept. Agrcl.
Pseudococcus agrifoliæ.
Ripersia villosa.

Quercus chyrsolepis.
Kermes rattani—U. S. Dept. Agrcl.
Pseudococcus quercus.
Xylococcus quercus.

Quercus lobata.
Aspidiotus yulupæ—U. S. Dept. Agrcl.
Chionaspis quercus—U. S. Dept. Agrcl.

Quince—see Cydonia.

Ramona polystachya (White Sage).
Ceroputo yuccæ—Bishop.
Pseudococcus crawii—Coquillett.

Ramona stachyoides (Black Sage).
Ceroputo yuccæ.

Raspberry—see Rubus.

Redwood—see Sequoia sempervirens.

Rhamnus californica.
Aspidiotus hederæ—U. S. Dept. Agrcl.
Chionaspis ortholobis—U. S. Dept. Agrcl.

Rhapis flobeliformis (Japanese Rattan Palm).
Pseudococcus adonidum. In greenhouses.

Rhododendron sp.?
Coccus hesperidum—U. S. Dept. Agrcl.
Pseudaonidia duplex. Only at quarantine—Ehrhorn.
Pseudaonidia pæoniæ—Ehrhorn.

Rhus sp.?
Aspidiotus hederæ—Woglum.
Chrysomphalus aurantii—Woglum.
Saissetia oleæ.

Rhus diversiloba (Poison Sumac).
Pulvinaria rhois.

Rhus integrifolia.
Aspidiotus hederæ—U. S. Dept. Agrcl.

Ribes sp.?
Aspidiotus ancylus—U. S. Dept. Agrcl.
Aspidiotus juglans-regiæ—U. S. Dept. Agrcl.
Chionaspis furfurus—U. S. Dept. Agrcl.

Ribes rubrum (Red Currant).
Aspidiotus hederæ.
Aspidiotus perniciosus.
Epidiaspis piricola.
Lepidosaphes ulmi.

Richardia africana (Calla Lily).
Saissetia oleæ. In greenhouse.

Ricinus communis (Castor Bean. Palma Crista).
Chrysomphalus aurantii—Maskew.
Saissetia oleæ.

Rosa sp.? (Rose).
Aspidiotus camelliæ.
Aspidiotus perniciosus.
Aulacaspis rosæ.
Chrysomphalus aurantii.
Lecanium pruinosum.
Lepidosaphes ulmi.
Icerya purchasi.
Saissetia oleæ.

Rubus nigrobaccus (Blackberry).
Aulacaspis rosæ.
Coccus hesperidum—Ehrhorn.

Rubus strigosus (Red Raspberry).
Aspidiotus perniciosus.
Aulacaspis rosæ.

Sage,
Black—see Ramona stachyoides.
California—see Artemisia californica.
White—see Ramona polystachya.

Sago Palm—see Cycas revoluta.

Salix sp.? (Willow).
Aspidiotus camelliæ.
Aspidiotus perniciosus.
Chionaspis ortholobis.
Chionaspis salicis-nigræ.
Pseudococcus bakeri.
Saissetia oleæ.

Salix babylonica.
Chionaspis wistariæ. Only at quarantine—Ehrhorn.

Salvia sp.?
Aspidiotus camelliæ—U. S. Dept. Agrcl.

Sambucus glauca (Elder).
Ceroputo yuccæ.
Pseudococcus bakeri.

Schinus molle (Pepper Tree).
Aspidiotus camelliæ.
Coccus hesperidum—Woglum.
Saissetia hemisphærica—Ehrhorn.
Saissetia oleæ—Ehrhorn.

Screw Pine—see Pandanus.

Sedge—see Carex.

Sedum sp.? (Stone crop).
Aspidiotus camelliæ. In greenhouses.

Selaginella sp.?
Pseudococcus citri in greenhouses.

Sequoia sempervirens (Redwood).
Aspidiotus hederæ—U. S. Dept. Agrcl.
Pseudococcus citri. In greenhouses.
Pseudococcus sequoiæ.

Silver Tree—see Leucadendron.

Slough Grass—see Spartina stricta.

Snow Ball—see Viburnum.

Solanum douglasii (Nightshade).
Chrysomphalus aurantii—Woglum.
Pseudococcus citri.
Pseudococcus solani—P. E. Smith.
Saissetia hemisphærica.
Saissetia oleæ.

Solanum tuberosum (Potato).
Pseudococcus citri—Bishop.

Solanum umbelliferarum.
Aspidiotus hederæ—U. S. Dept. Agrcl.

Solidago sp.?
Saissetia oleæ.

Spartina stricta (Slough Grass).
Chionaspis spartinæ.

Spike grass—see Distichlis maritima.

Spruce—see Picea.

Stachys pullata (incorrectly "Stachyos").
Phenacoccus stachyos.

Staghorn Fern—see Platycerium.

Stephanotis floribunda.
Coccus hesperidum.

Stone Crop—see Sedum.

Strawberry—see Fragaria.

Strelitzia gigantea.
Aspidiotus camelliæ.
Coccus hesperidum.
Pseudococcus adonidum.
Pseudococcus citri.

Strelitzia regina.
Aspidiotus camelliæ.
Coccus hesperidum.
Pseudococcus citri.

Sumac—see Rhus.

Sycamore—see Platanus racemosa.

Tacsonia sutherlandi.
Pseudococcus citri. In greenhouses.

Tea—see Thea.

Tecoma jasminoides.
Coccus hesperidum.
Pseudococcus citri.

Thea japonica (Japan Tea).
Lepidosaphes newsteadi. Only at quarantine—Ehrhorn.
Pseudaonidia pæoniæ. Only at quarantine—Ehrhorn.

Thuya sp.?
Diaspis carueli.

Thuya orientalis.
Pseudococcus ryani.

Toxylon pomiferum (Osage Orange).
Aspidiotus perniciosus.

Tradescantia multicolor (Wandering Jew).
Pseudococcus citri. In greenhouses.

Trisetum sucspicatum.
Exærtopus caricis.

Ulmus americana (Elm).
Aspidiotus perniciosus.
Gossyparia spuria.
Lecanium pruinosum—Whitney.
Lepidosaphes ulmi.

Umbellularia californica (California Bay Tree).
Aspidiotus camelliæ—U. S. Dept. Agrcl.
Aspidiotus hederæ—U. S. Dept. Agrcl.
Coccus hesperidum.

Umbrella Plant—see Cyperus.

Umbrella Tree—see Melia.

Urtica sp.? (Nettle).
Pseudococcus citri.

Viburnum sp.?
Phenacapsis latissima. Only at quarantine—Ehrhorn.

Vitis vinifera (Grape).
Aspidiotus camelliæ.
Aulacaspis rosæ.
Chrysomphalus aurantii.
Diaspis pentagona—U. S. Dept. Agrcl.
Lecanium persicæ.
Lecanium pruinosum—Coquillett.
Pulvinaris vitis.

Walnut—see Juglans-regia.

Wandering Jew—see Tradescantia multicolor.

Watermelon—see Citrullus vulgaris.

Wild Buckwheat—see Eriogonum fasciculatum.

Wistaria sp.?
Chionaspis wistariæ. Only at quarantine—Ehrhorn.

Willow—see Salix.

Yucca aloifolia.
Saissetia oleæ.

Yucca whipplei.
Aspidiotus hederæ.
Ceroputo yuccæ—Coquillett.

PRUNING THE ORANGE TREE TO PROMOTE THRIFT.

By Charles R. Paine, Crafton, Cal.

In the multitude of leaves on a navel orange tree the most are ordinarily two and one half inches by three fourths inches. If the tree is fairly vigorous, there are many among them four inches by one and three fourths inches wide. On larger parts of the limbs, when opportunity is given for their growth, there are some leaves five and one half inches by two and one half inches and larger ones on suckers.

Since a good proportion of large green leaves indicates thrift, the need for producing them is obvious.

If considerable part of the outer foliage consists of small leaves on feeble twigs, and they are yellowish, or, if the red spider has made inroads on their chloroaphyll, or scale hindered their activities, the food-constructing power is diminished; the health of the tree is affected, even on rich, well-cared for soil; and the fruit is inferior in proportion to the poverty of the foliage. If there is too great a ratio of very large leaves, as in young trees, and in sucker growths, the fruit corresponds in coarseness.

An approach to the best conditions of foliage for vigor and productiveness may be had by judicious pruning.

Allowing the weakened terminals to remain long — a kind of self-pruning method — will sometimes result in an openness of the branches so that new growths will form farther in and the tree will, to a degree, be renewed by the leaf activity in elaborating plant food. Such waiting is undesirable, for too great loss of vitality and time results.

The worn-out parts of all main branches which usually lie under or at the side of the newer, or better parts and are of less diameter, should be cut off; likewise the ranker up-growing shoots on such principal branches should be pruned away to avoid deterioration of the branch they grow upon.

The better parts, thus relieved, will become more vigorous and new large leaves will shortly appear on exposed parts of the limbs so treated.

A more expeditious process, giving better and more lasting results, consists in opening the top of the navel orange tree by cutting out limbs tending to upright growth, also the branches of all others that hang inward.

Sunburn on the bare parts of the slanting limbs remaining need not be feared, for, under solar influence, they will soon be covered with short-stemmed, broad-leafed shoots, that will be both fruitful as well as important factors in the food-making supply of the tree.

In consequence of this top opening, new foliage will spring from the inner wall which will also be fruit-bearing. Suckers will be few if the opening is generous and dead wood, once removed, can not be formed again, owing to active growth resulting from light in the interior and free circulation of air.

The two resultants of the reviving energy of good new leaves and increased fruiting more than offset the loss by removal of the branches cut out of the top which in old trees are too feeble and in young trees too rank for good fruiting.

If all trees, even the best, are kept free of branches more or less exhausted and from too vigorous shoots, their usefulness will be improved and old age be postponed.

When the interior is filled with new foliage the terminals, having slight recuperative powers, may be clipped off and the whole tree will be green and productive throughout.

THE ALFALFA WEEVIL SITUATION.

By G. E. Merrill.

The presence of the alfalfa weevil in Utah, Idaho and Wyoming and its consequent damage there have aroused in the minds of our alfalfa growers an interest in the pest that is second only to that felt by the

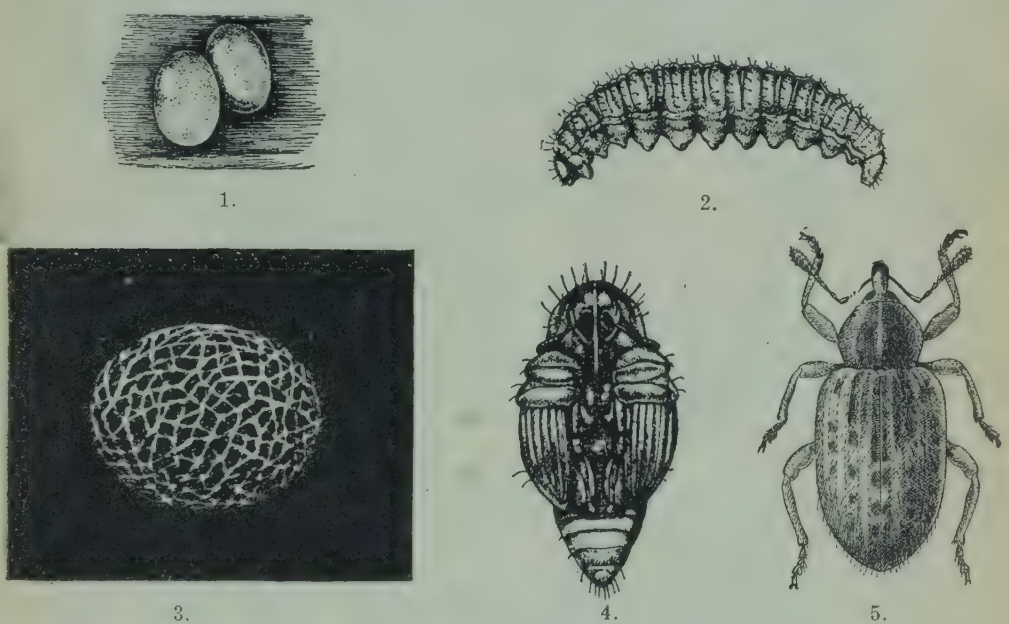

Fig. 226.—The alfalfa weevil (*Phytonomus posticus* Gyll.). 1, eggs; 2, larva; 3, cocoon; 4, pupa; 5, adult. (After Webster.)

fruit growers in the Mediterranean fruit fly. In this paper we intend to give the life history of the insect, a brief discussion of its importance as a pest in Utah, the means practiced for its control and the chances of its becoming established in California.

In preparing our account of its life history we have drawn freely on Bulletin 110 of the Utah Agricultural College Experiment Station, The Alfalfa Leaf Weevil by E. G. Titus and on Bulletin 112, Bureau of Entomology, Preliminary Report on the Alfalfa Weevil by F. M. Webster. Much of the other information in this paper was gathered by the

writer during a recent trip to the infested district, where he became acquainted with the Experiment Station men and the agents and experts of the Bureau of Entomology who are engaged in fighting the invader. The opinion of these men on many different points was asked for and received. In our conclusions we have been guided largely by these opinions, which so far as we can learn are well supported by facts.

For the illustrations used in this article we are indebted to the United States Department of Agriculture.

FIG. 227.—Work of the alfalfa weevil. 1, larvæ attacking a sprig of alfalfa, and eggs, *in situ*; 2, adults attacking alfalfa plant. (After Webster.)

Life History.—The alfalfa weevil (*Phytonomus posticus*) belongs to that large family of beetles known as the *Curculionida* or snout beetles. Its greatest damage is done to alfalfa, but it also feeds on certain species of lupines, peas, vetches and clovers. It passes through four complete metamorphoses — the egg, the larva, the pupa and the adult. The eggs (Fig. 226) are small in size, oval in shape, and when first laid

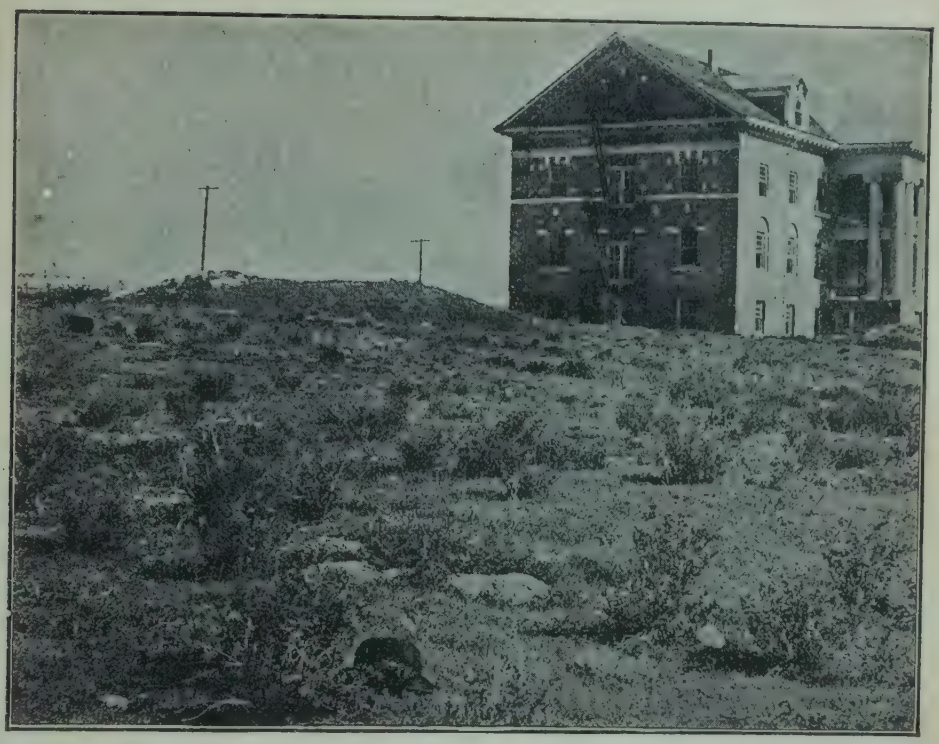

FIG. 228.—Volunteer growth of alfalfa on vacant lots in Salt Lake City. The alfalfa plant beside the hat contained at the time approximately 1,200 to 1,300 eggs. This was in the midst of the egg-laying season. (After Webster.)

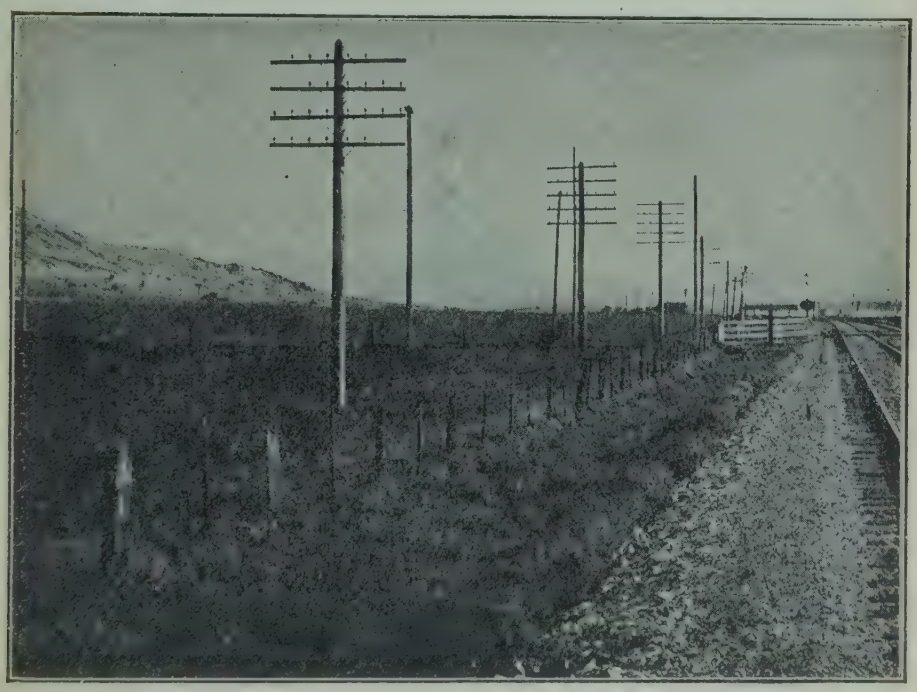

FIG. 229.—Volunteer alfalfa growing along the right of way of the Oregon Short Line Railway a short distance north of Salt Lake City, Utah. (After Webster.)

lemon yellow in color. They later become dark at one end and deep yellow at the other. The larger part of the eggs is laid in the spring time; in Utah, during the months of April, May, and June. They are thirty, with about ten as a general average. It is by no means unusual

FIG. 230.—Hibernating places of the alfalfa weevil along fences in the vicinity of Salt Lake City, Utah. (After Webster.)

arranged in clusters in feeding punctures on the tender alfalfa stems or in punctures made by the beak of the adult solely for the purpose of oviposition. The number placed in each cavity varies from two to for a healthy female to deposit several hundred eggs if conditions remain suitable throughout the egg-laying period.

FIG. 231.—One of the main irrigation ditches in the Salt Lake Valley, a favorable hibernating place for alfalfa weevils. (After Webster.)

The time required for hatching varies considerably. Under ordinary conditions from ten to twelve days are necessary.

When first hatched the larvæ are small, active and begin at once to feed on the inner parts of the stem in which they were hatched. They

feed in this location for three or four days, and then with relatively few exceptions emerge and work their way up on the outside of the stem until they find a leaf bud into which they may eat and grow in more or less complete concealment. The larvæ pass through three moults and reach the pupa stage in three to seven weeks. When full grown and about to pupate, a larva seeks shelter within the crown of a plant or among pieces of bark and litter on the ground and there spins a cocoon, composed of fine white threads. Fig. 226 shows the appearance of the cocoon. Before pupating the insect remains in the larval stage within the cocoon from three to five days. About nine days are passed in the pupa state, and within a day after the transformation the adult leaves the cocoon.

FIG. 232.—One of the worst infested fields in the Salt Lake Valley, showing injury to the first crop of alfalfa, which was left uncut. Photographed June 26, 1911. (After Webster.)

The adult weevil, Fig. 226, is a small beetle, less than one fourth of an inch long. The body is covered mainly with short, dark brown hairs, among which are mixed clusters of gray and black ones; as a result the beetle has the appearance of being brown in color, spotted with black. Individuals from which the hair has been rubbed appear very dark brown or even black in color.

The adult weevil is an active feeder and damages the stem, leaves and buds of the alfalfa plant. The sexes are almost evenly represented. Some points in the habits of the weevil are not yet fully determined, but it is known that some individuals mate soon after emerging from the cocoons and that as a result of these matings fertile eggs are laid, which appear to give rise to a second brood. But the greater number of insects pass the winter before reproducing themselves. With the approach of cold weather the insects become less active and seek almost

any kind of shelter, particularly about the crown of the plant and under all kinds of rubbish, trash or litter in the infested fields or near them. Figs. 230 and 231 show typical situations for hibernation.

FIG. 233.—*a*, Bunch of alfalfa uninjured by the alfalfa weevil; *b*, bunch of alfalfa badly injured by the alfalfa weevil, showing growth made by first crop in the badly infested fields. (After Webster.)

When warm weather comes the weevils become active, mate and begin the work of feeding and oviposition about as soon as the alfalfa begins to develop. Flights to new feeding grounds also take place during the spring, but these flights are not likely to be so long as those of summer.

FIG. 234.—Crop secured from first cutting of one of the worst infested fields. (After Webster.)

Spread.—The adult alfalfa weevil, as has been stated, is an active crawler and flyer. The greatest spread probably takes place soon after emergence from the cocoon. At this time the insects are active, fly high and are probably carried long distances by the wind. This conclusion is borne out by the fact that the most rapid and complete dissemination in the infested territory has taken place in the direction of the prevail-

FIG. 235.—First cutting from another field damaged by attacks of the alfalfa weevil. (After Webster.)

ing winds. Indeed, it is difficult to account for the presence of the pest in some of the infested localities, except in some such way as indicated in the foregoing. Although the insect hides in freight cars, wagons, fruit boxes, beehives, passenger cars and countless other movable objects, there is no well authenticated instance of its establishment in new territory in America by artificial means.

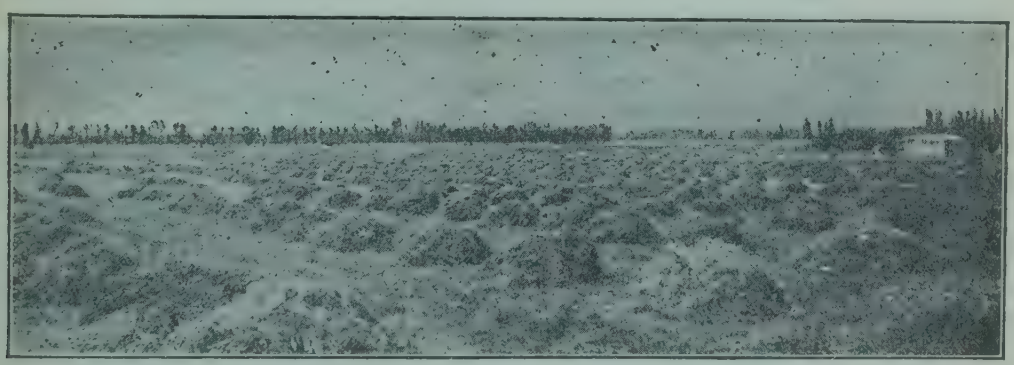

FIG. 236.—First cutting secured from one of the fields of alfalfa slightly injured by the weevil. (After Webster.)

Importance as a Pest.—The greater part of the alfalfa growing district of Utah is now infested to a greater or less degree. The pest has been established long enough in some localities for growers and others to have become familiar with the general aspects of the damage caused. The ravages of the insect are particularly pronounced in fields that have been in alfalfa for eight years or more, especially where such

fields suffer from a shortage of water or from any other cause that interferes with a vigorous development of the crop. In fields of this type the loss of the first and second crops is sometimes complete and the third crop may be too small to be profitably handled. Figs. 232, 233 and 234 show the effect of the weevil on alfalfa.

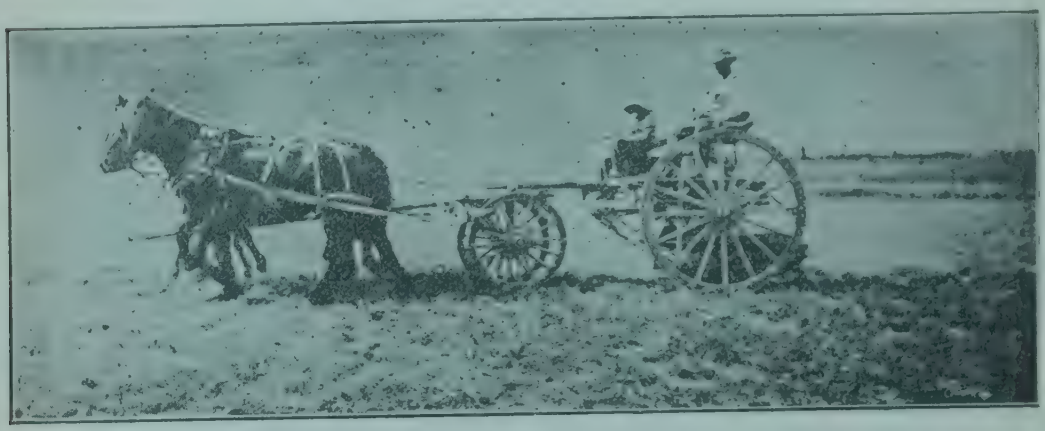

FIG. 237.—Street sweeper in operation on alfalfa field after first crop was removed. Larvæ and pupæ were crushed by the rotary brush. (After Webster.)

The weevil has become a much more important pest in America than it has ever been in its native home about the shores of the Mediterranean. This condition appears to be due to the fact that the dividing lines between different stages in the life history of the insect is more

FIG. 238.—Second crop ready to cut in the field on which the street sweeper was used. Good stand and good crop. (After Webster.)

clearly defined here than abroad. That is, the bulk of the eggs hatch all at once here, while abroad the hatching period is more prolonged because of the overlapping of the seasons. In America, consequently, the attack of the young insects is like the onslaught of an army, while abroad the attack is loose and unorganized. From the statements

FIG. 239.—Second crop of alfalfa growing on field where no treatment was given. Crop short and about two weeks behind that shown in Fig. 238. (After Webster.)

FIG. 240.—Wire-brush cultivator in operation on alfalfa field after first crop was removed. The brushes crushed the larvæ and pupæ on the ground. (After Webster.)

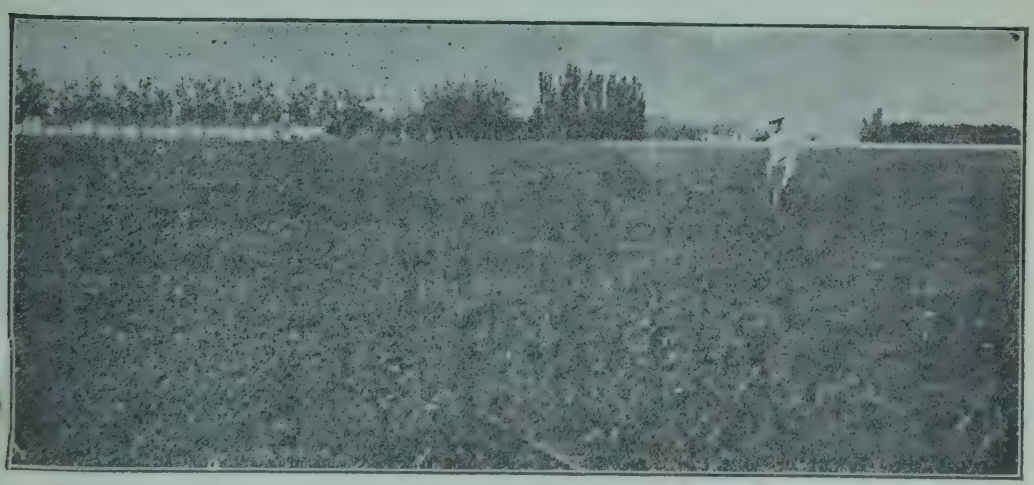

FIG. 241.—Second crop growing nicely as result of the wire-brush treatment. (After Webster.)

made in the foregoing we may hope that should the weevil ever become established in California, its ravages would not be so severe as in Utah

Control Measures.—Control of the weevil has been sought in many different ways. Attempts have been made to burn or crush the larvæ and adults and to puddle them with mud. Figs. 240, 247, and 251 show

FIG. 242.—Condition of untreated fields about June. (After Webster.)

some of the devices that have been employed. About the only control measures that promise commercial success are those that have as a basis the stimulation or forcing of the alfalfa plants. The best results so far have been obtained by cultivating the alfalfa after each cutting with

FIG. 243.—Second crop of alfalfa, estimated at 2 tons per acre, secured from field treated with wire-brush cultivator. (After Webster.)

spring-tooth harrows with a wire brush attachment (shown in Fig. 240) to the teeth or with a simple brush harrow. The dust mulch raised by the use of either of these two implements is offensive to the insect, and the growth of the crop is stimulated by the conservation of moisture and

FIG. 244.—Fourth crop of alfalfa secured from field where the wire-brush cultivator was used. (After Webster.)

FIG. 245.—Condition of untreated field used as a check. The second and third crops on this field made little growth and were much delayed, so what would correspond to the fourth crop was caught by frost. (After Webster.)

FIG. 246. Alfalfa field after first crop was removed, severely disked preparatory to application of "mudding" process against the alfalfa weevil. (After Webster.)

otherwise. So effective has this treatment proved in some instances that alfalfa fields in badly infested districts have been found to yield better crops than they had for years before the pest became established in Utah. The cost of this treatment is comparatively little — from $2.00 to $5.00 per acre a year.

FIG. 247.—Following the irrigation water with a drag, to "puddle" the weevils in the mud. (After Webster.)

Menace to California.—From what has been said the chances of keeping the pest out of California forever do not appear good. However, there is much consolation in the fact that we are isolated from the infested districts by a series of mountain ranges and deserts, and many years we hope may pass before our fields are affected.

FIG. 248.—Second crop of alfalfa in field treated by "mudding" process. Crop growing well and not seriously damaged by the alfalfa weevil. (After Webster.)

FIG. 249.—Condition of untreated fields at time photograph of Fig. 248 was taken. The alfalfa weevil has prevented the second crop from starting. (After Webster.)

FIG. 250.—Patch of first crop left in the field shown in Fig. 248, illustrating how the larvæ were disseminated from the first crop into the field where the weevil had been killed by the "mudding" process. (After Webster.)

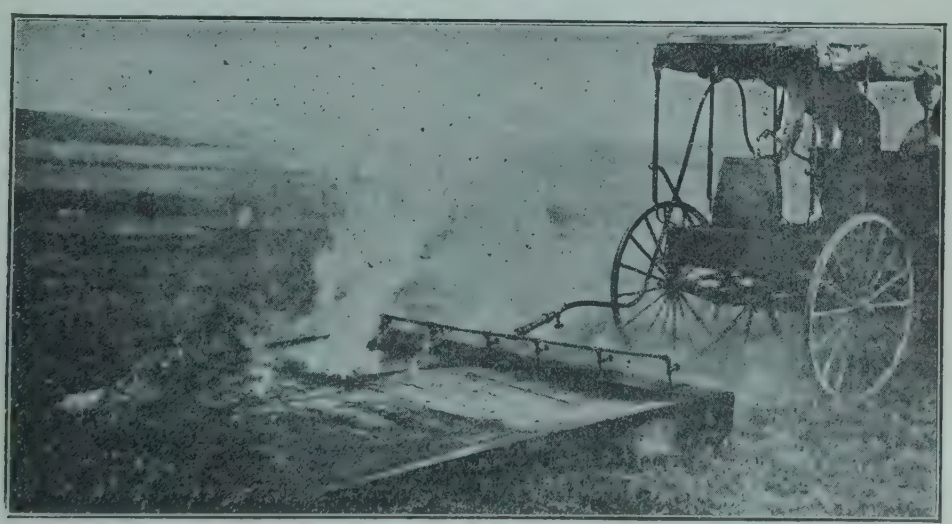

FIG. 251.—Burning machine experimented with as a method of destroying the alfalfa weevil. (After Webster.)

The men in charge of the government work are unanimous in the opinion that little can be done in the way of keeping the pest out of California by quarantine measures. A quarantine to be effective would practically prohibit the movement of cattle, freight, and passenger cars from or through the infested territory to California. The government experts are also of the opinion that there would be practically no danger in the admission of properly prepared alfalfa seed. The facts so far as learned certainly seem to support this opinion.

The movement of hay from the infested territory is probably the most important avenue of artificial distribution. Fortunately this movement is light, as almost all the hay produced in the infested territory is consumed there. Practically no hay from the badly infested district has been shipped to California, and in the future such shipments will be entirely prohibited through the enforcement of Quarantine Order No. 14.

JULY CROP REPORT.

By G. E. Merrill.

Almonds.—Reports from eight important almond growing counties show an average crop condition of 95 per cent, as compared with last year's. Considerable damage from hot weather, lack of moisture and red spider, is reported. Mr. Garden, commissioner for San Joaquin County, says that the percentage of "stick tights" will be large on account of lack of moisture. A summing up of our reports this month indicates a considerable falling off in the almond crop prospects.

Apples.—The apple situation in Santa Cruz County appears to have improved since the issuance of the June report. Last year's crop will be exceeded, and this year's fruit is developing well, is of good size and smooth skinned. The Sonoma County Gravenstein situation appears unchanged. This year's crop will be slightly in excess of last. Other apple growing districts in California report crop prospects in excess of last year's or equal to it.

Government reports from 14 of the principal apple growing states show a decrease of 5 per cent as compared with last month's, or an average of 73 per cent, as compared with 70 per cent last year, and a ten year average of 70 per cent. The latest available Canadian reports indicate that there will be an excellent apple crop in the principal apple growing sections of the Dominion.

Apricots.—The apricot harvest is now well under way. Generally speaking, there is little change from the situation as outlined in the June report.

Grapes.—Considerable damage from hot weather, or lack of moisture is reported from San Joaquin, Solano, Kings and Contra Costa counties. The grape crop prospects are materially less than the June report indicated.

Government reports from fourteen of the principal grape growing states show an average condition this year of 80 per cent, as compared with 83 per cent last year, and a ten year average of 87 per cent. The government reports make no distinction between wine and table grapes, and, of course, refer almost entirely to table grapes.

Lemons.—The lemon crop still promises to be light. Generally speaking, this month's situation is the same as last, except that an increase of 10 per cent is noted in Orange County. San Bernardino reports a lemon crop 85 per cent of normal, and San Diego 90 per cent of last year's. The winter setting in the Ventura orchards is reported to be fair; the spring setting good. The Florida lemon crop is slightly better this year than usual.

Oranges.—The orange outlook is better than the June report indicated. Orange County reports promise a crop 20 per cent greater than last year's. Ventura and Riverside counties report normal crops, and San Bernardino, Butte, Santa Barbara, San Diego, and Los Angeles counties all report prospects of 85 and 95 per cent of last year's crop. Tulare County reports a severe drop of navels, and estimates this year's navel crop at 50 per cent of last year's. Valencias promise well in Tulare County. Florida reports a 95 per cent crop, as compared with a six year average of 77 per cent.

Peaches.—The peach harvest is now well under way, and the peach situation appears unchanged from last month, except that the effects of the lack of moisture are apparent in some orchards, and that the government report shows a condition on July 1st of 59 per cent, as compared wth 64 per cent on June 1st, and an average of 52 per cent last year, and a ten year average of 49 per cent.

Pears.—The pear shipping season is at its height. More pears will be harvested than our previous reports have indicated. This is due in part, at least, to the extensive use of new irrigating plants. More than 100 pumping plants were installed this season in the Sacramento County pear growing districts.

The July government report shows practically the same conditions throughout the country as indicated in the June report.

Prunes.—Conflicting reports regarding the prune crop have been received. Damage from hot weather, lack of moisture and red spider have been reported from Tehama, Shasta, Solano and Contra Costa counties. Santa Clara prospects still continue good, estimates of the crop ranging from 65 to 100 per cent of last year's crop. There is much premature ripening in some of the dryer orchards, and the prunes will doubtless be of small size in many of these orchards. Judging from the best information we can obtain, this year's prune crop still promises to be somewhat smaller than that of last year.

Reports thus far received from abroad indicate that the foreign crop of prunes will not be heavy. The same statement is also true of the other dried fruits and nuts produced abroad.

Walnuts.—The walnut crop prospects continue to indicate that there will not be a heavy production. Los Angeles, Santa Barbara, Orange, and Ventura counties, which comprise the principal walnut growing districts of the State, report this year's crop prospects at 75 to 80 per cent of last year's.

AUGUST CROP REPORT.

By G. E. Merrill.

Apples.—The apple outlook still continues good. Last year's crop in this State will probably be exceeded 35 to 40 per cent. Santa Cruz County reports indicate 50 per cent more apples there this year than last, while Monterey County reports a crop 90 per cent of last year's. The Gravenstein harvest in Sonoma County is about completed. The fruit was of fine quality and the crop larger than last year's.

Grapes.—Since the issuance of last month's report much damage has developed especially to table grapes. The loss has resulted principally from dry weather and fungous troubles. Placer, Sacramento, Stanislaus, and San Joaquin counties, all important table grape producers, report that in no case will this year's crop be more than 60 per cent of normal, and in many instances not half a crop is anticipated. In the other table grape growing districts the situation is better. Sonoma, Riverside, Shasta, El Dorado, and Los Angeles counties report prospects 75 to 100 per cent of last year's.

The wine grape outlook is not so promising as early prospects indicated. However, Madera, Lake and Solano counties report crops equal to or in excess of last year's.

The raisin grape situation appears better, as much better crops than usual are reported in Fresno and Madera counties.

Lemons.—The lemon crop, except in Orange County, promises to be about 80 per cent of normal, or considerably less than last year's crop. In Orange County a yield one fifth greater than last year's is promised, largely because of new acreage coming into bearing.

Olives.—With the exception of those from Shasta and Santa Barbara counties, all reports indicate a marked deficiency in olives for this season. But 25 per cent of last year's crop is reported from Los Angeles, Stanislaus and San Bernardino counties. The situation is even worse in Tehama and Madera counties, and Sacramento and Riverside counties report prospects in no case to be 60 per cent of last year's crop.

Oranges.—The navel orange situation appears to have improved since our last report. The drop in the Porterville district was not as bad as early reports indicated. Riverside, San Bernardino, Los Angeles and Santa Barbara counties report prospects of a crop from 85 to 95 per

cent of last year's. Crops of Valencia oranges, considerably in excess of last year's, are promised both in Ventura and Orange counties.

Peaches.—The peach harvest is now well under way, and a large crop is being gathered. Considerable complaint has been noted of small size, due to dry weather, but in the well watered districts the crop is excellent in quality.

Prunes.—Prune picking is now fairly well under way. Many reports of small size, due to dry weather, have been received. Sonoma County prospects appear to have decreased about 10 per cent since the issuance of our last report. Santa Clara County, and other prune district reports indicate little change from last month's situation. This year's prune crop will be considerably under that of last year.

Walnuts.—The walnut situation is little changed. About 80 per cent of last year's production is promised from the principal walnut growing districts.

CHECK LIST OF CALIFORNIA INSECTS II.

By C. W. Woodworth, Professor of Economic Entomology, University of California, Berkeley, Cal.

NOCTUIDÆ.[1]

Abagrotis erratica—Triphæna.
Ablepharon absidum—Copablepharon.
Acerra *addenda*—Monima.
behrensiana—Xylomania.
erythrolita—Xylomania.
muricina (Oregon).
mys—Monima.
normalis—Perigrapha.
plusiiformis (Colorado).
pulchella—Perigrapha.
transparens—Perigrapha.
Acontia *angustipennis*—Conaconia.
areli—Tarache.
arizoniæ—Tarache elegantula.
behrii—Tarache.
coquilletti—Tarache.
elegantula—Conochares.
flavipennis—Tarache.
gonella Tarache.
lucasi Tarache.
Acronycta felina (Grote).
frigida Smith.
hesperina Smith.
impleta Walk.
lepusculina (eastern).
lithospila Grote.
lupina—Merolonche.
mansueta Smith.
marmorata Smith.
othella Smith.
pacifica Smith.
perdita Grote.
quradata Grote.
simplex—Xylomania.
spinea—Merolonche.
Actinotia stewarti—Delta.
Adelphagrotis apposita Eurois.
indeterminata Eurois.
quarta Eurois.
Admetovis oxymorus Grote.
similis Barnes.
Adonisea languida—Heliothis pulchripennis.
pulchripennis—Heliothis.
Aedophron pallens Smith.
Agassizia urbicolor Behr.
Agriopodes viridata (Harv.).
Agroperina cogitata (Walk.).
Agrophila tortricina Zell.
Agrotis *abnormalis*—Tarachidia.
abnormis—Euxoa.
ancipennis—Feltia.
æqualis—Euxoa wilsonii.
agrestis—Euxoa.
albipennis—Euxoa.
alticola—Euxoa.
annexa—Feltia.
apposita—Eurois.
atomarius—Euxoa.
atrifera—Euxoa.
auxiliaris—Euxoa agrestis.
bicollaris—Euxoa.
brevipennis—Euxoa.
brunneigera—Euxoa.
carissima—Triphæna.
catenula—Porosagrotis.
cicatrosa—Euxoa.
cinereicollis Grote.
clandestina—havilæ.
clemens Smith.
cogitans—Euxoa choris.
colata—Euxoa.
costata—Triphæna.
crenulata—Triphæna.
cupidissima—Triphæna.
discoidalis—Triphæna.
divergens—Euxoa.
erratica—Triphæna.
emarginata—Triphæna formalis.
euroides—Euxoa venusta.
evanidalis—Feltia.
excellens—Euxoa.
exsertistigmus—Triphæna.
facula—Triphæna formalis.
fauna—Euxoa.
fenisica—Euxoa.
formalis—Triphæna.
friabilis—Euxoa.
furtivus—Euxoa.
fuscigera—Euxoa.
gagates—Euxoa.
gravis—Feltia.
havilæ Grote.
hollemani—Euxoa.
incallida—Euxoa.
incivis—Peridromia.
inelegans—Triphæna.
infelix—Euxoa excellens.

[1]The list of Noctuidæ presented in part one (The Monthly Bulletin, Vol. I, No. 7, pages 306-312) is based on the catalogue of Dyar published by the U. S. National Museum with only a few changes suggested by American writers. The British Museum is now publishing a catalogue by Hampson which is making many radical changes. Only about half of the Noctuidæ (7 volumes) has been published. According to this work scarcely any of the names that apply to California species remain unchanged and many entomologists are not ready to adapt these changes and for these the foregoing list was given. It is likely, however, that the British list, at least in its main features, will be finally accepted by entomologists generally.

Agrotis *infimatis*—Anomogyna.
innotabilis—Eurois indeterminata.
insignata—Euxoa.
intrita—Euxoa.
introferens—Euxoa auxiliaris.
lacunosa—Euxoa.
lætula—Triphæna.
lagena—Euxoa.
lutulenta—Euxoa.
malefida—Feltia.
mercenaria—Euxoa agrestis.
messoria—Euxoa.
micronyx—Euxoa.
milleri—Feltia.
mimallonis—Porosagrotis.
nostra—Euxoa.
observabilis — Triphæna exserti-stigma.
orbis—Triphæna variata.
oblata Morr.
oblongistigma—Euxoa.
pallidicollis—cinereicollis.
perfusca—Euxoa.
plagigera—Euxoa.
punctigera—Euxoa.
pyrophiloides—Noctua.
quadridentata—Euxoa.
quarta—Eurois.
quinquelinea—Euxoa.
radix—Polia.
recula—Euxoa.
rema—Euxoa.
remota—Euxoa.
rena—Euxoa.
rosaria Grote.
rufipectus—Triphæna.
satis—Euxoa.
segregata—Euxoa.
sierræ How.
serricornis—Euxoa.
silens—Euxoa.
specialis—Euxoa wilsoni.
spectranda—Euxoa verticalis.
tesselloides—Euxoa.
vaucouverensis—Feltia.
variata—Triphæna.
venerabilis—Feltia.
verticalis—Euxoa.
vorax—Homoncocnemis fortis.
vernalis—Anomogyna.
volubilis—Feltia.
wilsonii—Euxoa.
ypsilon Rott.
Amathes bicolorago (Guen.).
fornica (Smith).
purpurea (Grote).
Amphipyra glabella (Morr.).
pyramidoides Guen.
Anarta *kelloggi* Symphistis.
mimuli Behr.
Andropolia maxima (Dyar).
olorian (Grote).
theodora (Grote).
Annaphila *amicula*—decia.
arvalis Edw.
aurantiaca—Incita.
danistica Grote.
casta Edw.
decia Grote.
Annaphila depicta Grote.
diva Grote.
divinula Edw.
domina Edw.
germana Edw.
lithosina Edw.
mera Harv.
miona Smith.
salicis arvalis.
superba Edw.
Anomogyna infimatis (Grote).
vernilis (Grote).
Antaplaga koebelei Riley.
Anytus evalina (French).
privata (Walk.).
sculptus—privata.
Apamea *cogitata*—Agroperina.
lunata Smith.
nictitans (Linn.).
Apatela *felina* Acronycta.
frigida Acronycta.
hesperida Acronycta.
impleta Acronycta.
lepusculina (Eastern).
lupina Merolonche.
mansueta Acronycta.
marmorata Acronycta.
pacifica Acronycta.
perdita Acronycta.
quadrata Acronycta.
spinea—Merolonche.
theodori—Andropolia.
Aporophila yosemitæ Grote.
Archenaria alameda (Smith).
Arsilonche *albovenosa* (Goez).
Arthrochlora februalis—Monophana.
Aspila subflexa—Chloridia virescens.
Athetis drasteroides (Smith).
extima (Walk.).
Atethmia canescens—Calymnia orina.
Auchmis confusa—Morrisonia.
Autographa albavitta Ott.
biloba Steph.
brassica (Ril.).
falcigera Kirby.
gamma (Linn.).
labrosa (Grote).
ou (Guen.).
pasiphæia Grote.
Axenus *amplus*—arvalis.
arvalis (Grote).
ochraceus—arvalis.
Balsa albopunctella Walk.
Behrensia conchiformis Grote.
Bolina cinis (unidentified).
hadeniformis (unidentified).
jucunde (unidentified).

Bombycia curvifascia (Smith).
elda (French).
Bombyx odora—Erebus.
Bomolocha incusalis—Pleonectyptera.
Brachylomia rectifascia (Smith).
Bryomima fallax (Smith).
Bryophila fascia (Smith).
viridata—Agriopodes.
Cabaloides franciscana (Smith).
Cabalos franciscanus—Cabaloides.
Cænurgia adversa (Grote).
Calymnia orina (Guen.).
Capnodes californica Behr.
Caradrina *drasteroides*—Athetis.
exigua Hübn.
extimia Athetis.
flavimacula—Laphygma.
glabella—Amphipyra.
leucorena Namangana.
miranda Proxenus.
Carneades Euxoa.
Catabena lineolata Walk.
Catocala adromache Edw.
adulterata (not authentic).
aholibah Stretch.
aspasia Stretch.
augusta—aspasia.
californica Edw.
cleopatra—californica.
electilis—californica.
faustina Stretch.
francesca—mariana.
fratercula G. & R.
hermia Edw.
hippolytia Edw.
ilia (Cram).
irene—californica.
jessica Edw.
junctura (eastern).
mariana Edw.
marmorata Edw.
perdita—faustina.
portia—stretchii.
relicta Walk.
stretchii Behr.
verilliana Grote.
virgilia—irene.
volumina—irene.
zoe—ilia.
Cea cirphidia Ham.
Celæna contrahens—Eriopyge.
Cerapoda oblita (Grote).
Cerma *fascia*—Bryophila.
olivacea Sm.
Chabulata fistula (Harv.).
Charadra decora Morr.
extimia Walk.
miranda Grote.
Cheophora blanda—Mythimna.
Chloridea armigera (Hübn.).
phloxiphaga (G. & R.).
subflexa virescens.
virescens Fabr.
Chorizagrotis *agrestis* Euxoa.
auxiliaria Euxoa.
introferens Euxoa auxiliaris.
Chytonix parvimacula Smith.
Cirphis dia (Grote).
farcta (Grote).
insueta (Guen.).
palliseca (Smith).
Cirrhobolina mexicana (Edw.).
tetrica (Edw.).
Cissura biformata (Edw.).
scropulosa (Edw.).
subtermina (Sm.).
Cleoceris curvifascia—Bombycia.
elda—Bombycia.
rectifascia—Brachylomia.
Cleophana eulepis—Copicucullia.
occata—Oncocnemis.
Cobaliodes angelicus Smith.
franciscanus Smith.
Conacontia angustipennis (Grote).
Conochares altera (Smith).
elegantula (Harv.).
interrupta Smith.
Copablephron absidum (Harv.).
Copibryophila angelica Smith.
Copicucullia eulepis (Grote).
Cosmia orina—Calypinia.
sambuci—Zotheca tranquila.
Crimona pallimedia Smith.
Cucullia serraticornis Lint.
solidaginis Behr.
Cyathissa pallida—Emarginea.
Dargida procinctus (Hadena).
Delta stewarti (Grote).
Deva palligera—Panchrysa.
Dianthœcia insolens—Polia.
leucogramma—Polia.
pensilis—Polia.
rufula—Eriopyge.
Dicopis damnalis—Eutolype.
Drasteria cærulea Grote.
Discestra chartaria (Grote).
Dryobata apina—Dryotype.
curvifascia—Bombycia.
elda—Bombycia.
rectifascia—Brachylomia.
Dryotype apina (Grote).
Dysocnemis prorupta (Grote).
oregonica (Edw.).
Epia minorata (Smith).
Emarginea pallida (Smith).
Epizeuxis lubricalis (Geyer).
Erebus odora (Linn.).
Eremobia unicincta (Smith).
Eudryas brevipennis Stretch.
Eriopyge affurata Ham.
contrahens (Walk.).
curtica (Smith).
irrorata (Smith).
perbrunnea (Grote).
puerilis (Grote).
rufula (Grote).
Euharvega carbonaria Harv.
Euherrichia cervina—Protophana.
Eumestleta carmelita Morr.
daria (Druce).
Euplexia lucipara (Linn.).
Eupsephopæctes procinctus—Hadena.

Eurois apposita (Grote).
indeterminata (Walk.).
pluviosa—Parastichtis arctica.
quarta (Grote).
Euros proprius—Sympistis.
Eustrotia includens (Walk.).
penita—includens.
Euthisarotia brevipennis—Eudryas.
Eutolype dramalis (Grote).
perscripta—Lepipolys.
Eutricopsis nexilis Morr.
Euxoa abnormis (Smith).
acutifrons (Smith).
agrestis (Grote).
albipennis (Grote).
alticola (Smith).
atomaris (Smith).
atrifer Grote.
auxiliaris (Grote).
bicollaris Grote.
bifirmata Smith.
brevipennis (Smith).
brunniegera (Grote).
cæcius (Smith).
choris (Harv.).
cicatrosa (Grote).
cogitans (Smith).
colata Grote.
compressipennis (Smith).
divergens (Walk.).
excellens (Grote).
fauna (Morr.).
feniseca (Harv.).
flutea Smith.
friabilis (Grote).
fulda (Smith).
furtivus (Smith).
fuscigera Grote.
fusimacula Smith.
gagates (Grote).
henrietta (Smith).
hollemani (Grote).
incallida (Smith).
incubita (Smith).
insignata (Walk.).
insulsa messoria.
intrita Morr.
intrusa (Smith).
lacunosa (Grote).
lagena (Grote).
laminis (Smith).
loya (Smith).
lutulenta (Smith).
messoria (Harr.).
micronyx (Grote).
nævulus (Smith).
nevada Smith.
noctuiformis (Smith).
nostra (Smith).
oblongistigma (Smith).
perexcellens—excellens.
perfusca (Grote).
plagigera (Morr.).
punctigera Walk.
quaradridentata (G. & R.).
quinquelinea (Smith).
recula (Harv.).
relaxus (Smith).
remota (Smith).
rena (Smith).
satis Harv.
segregata (Smith).
selenis (Smith).
septentrionalis (Walk.).
serricornis (Smith).
silens Grote.
spectanda—verticalis.
tesselloides Grote.
tocoyæ (Smith).
vanidica (Smith).
verticalis (Grote).
vetusta Walk.
wilsonii (Grote).
Fala phycophora Grote.
Feltia æneipennis (Grote).
annexa (Triet.).
evanidalis (Grote).
gravis (Grote).
malefida (Guen.).
milleri (Grote).
vancouverensis (Grote).
venerabilis (Walk.).
volubilis (Harv.).
Feralia februalis—Moniphana.
Fruva *acerba*—Tarache.
modesta Edw.
Galgula partita Guen.
Glœa olivata—Psectraglæa.
Gortyna albilunata—Apamea lunata.
nictitans—Apamea.
obliqua—Hydrœcia.
sawzalita—Ochria.
Græperia megocula (Smith).
Graphiphora artholita—Monima.
behrensiana—Xylomania.
curtica—Eriopyge.
erythrolita—Xylomania.
furfurata—Eriopyge affurata.
muricina (Colorado).
normalis—Perigrapha.
pacifica—Monima.
pectinata—Perigrapha.
perbrunnea—Eriopyge.
præses—Perigrapha.
puerilis—Eriopyge.
pulchella—Perigrapha.
rubrica—Xylomania.
rufula—Eriopyge.
terminata—Perigrapha.
Graptolitha contenta (Grote).
dilatocula (Smith).
gausapata (Grote).
oregonensis (Harv.).
puella (Smith).
Gyros muirii (Edw.).
Hadena *adnixa*—Tarache.
albina—Parasticta.
antennata—Parastichtis.
arctica—Parastichtis.
binotata—Trachea.

Hadena *castanea*—Parastichtis arctica.
catalina—Trachea.
centralis—Trachea.
cinefacta—Trachea.
cogitata—Agroperina.
cuculiformis—Parastichtis.
curvata—Trachea binotata.
cymosa—Parastichtis castanea.
devastatrix—Sidemia.
didonea—Xylomania.
divesta—Trachea.
evelina—Anytus.
ethnica—Trachea.
fumeola—Trachea.
genetrix—Trachea.
genialis—Parastichtis.
glorina—Polia.
inconspicua—Trachea paviæ.
indirecta—Trachea.
lævigata—Oligia.
marina—Trachea.
mustelina—Trachea.
occidens—Parastichtis.
olorina—Andropolia.
pausis—Trachea.
pavia—Trachea.
pluviosa—Parastichtis arctica.
procincta (Grote).
rectifascia—Cleoceris.
relicina—Parastichtis.
stricta—Polia.
susquesa—Trachea.
tusa—Trachea.
unicincta—Eremobia.
violacea—Oligia.
Hecatera laudabilis—Polia.
Hagena cuculliformis—Parastichtis.
Helia occidentalis—Epizeris lubricolis.
Heliaca diminutiva—Heliothodes.
nexilis—Eutricopsis.
ranunculi—Xanthothrix.
Heliodes angelica Smith.
restrictalis—Microhelia.
Heliosea pictipennis Grote.
Heliolonche modicella Grote.
Heliophana amarylis Smith.
Heliophila dia—Cirphis.
farcta—Cirphis.
heterodoxa—Cirphis insueta.
megadia—Cirphis dia.
minorata—Leucania.
oxygale—Leucania.
palliscca—Cirphis.
Heliosea pictipennis (Grote).
Heliothis *armiger*—Chloridia.
californica—sueta.
celeris (Grote).
crotchii—Schinia cupes.
cupes—Schinia.
diminutiva—Heliothodes.
græfiana (Tep.).
lanul—Schinia.
pulchripennis (Grote).
phlogophagus—Chloridia phloxiphaga.
proruptus—Dysocnemis.
sueta (Grote).
vacciniæ (Edw.).
villosa (Grote).
Heliothodes diminutivus (Grote).
fasciata (Edw.).
Herrichia cervina—Protophana.
Heterogramma palligera—Tetanolita.
Himella furfurata—Eriopyge affurata.
Homoglæa californica (Smith).
carbonaria (Harv.).
Homohadena chorda Oncocnemis.
deserta—Litocala sexsignata
elda—Bombycia.
figurata Oncocnemis.
fortis—Homococnemis.
picina—Homococnemis fortis.
Homoncocnemis fortis (Grote).
Homoptera salicis—Phæcyma.
rosæ—Phæcyma salicis.
rubi—Phæcyma.
Hoplolythra discistriga (Smith).
Hydrœcia *albilunata*—Apamea lunata.
angelica—Papaipema.
lunata—Apamea.
obliqua (Harv.).
pacifica—Apamea nictitans.
Hypena californica Behr.
decorata—californica.
modesta Smith.
Hyssia niveoguttata (Grote).
Incita aurantiacus (Edw.).
Ingura cristatrix—Pæctes.
declinata—Pæctes.
Jaspidia viridata—Agriopodes.
Laphygma flavimaculata Harv.
Lepipolys perscripta Guen.
behrensi (Grote).
Lasionycta arietis (Grote).
ochracea (Grote).
Leucania *dia*—Cirphis.
farcta—Cirphis.
henrici—Simyra.
heterodoca—Cirphis insueta.
minorata Smith.
oxygala (Grote).
pallens (Linn.).
Leucanitis adumbrata—Syneda.
edwardsii—Syneda.
maculosa—Syneda.
nubicula—Syneda.
ochracea—Syneda.
stretchii—Syneda howlandii.
socia—Syneda.
tejonica—Syneda.
Litholomia napæa (Morr.).
Lithophane carbonaria—Homoglæa.
contenta—Graptolitha.
gausapata—Graptolitha.
oregoncnsis—Graptolitha.
Litocala sexsignata Harv.

Litosea adversa—Cænurgia.
Luperina posticata (Harv.).
Lycophotia lubricans (Guen.).
margaritosa (Harv.).
radiola Ham.
Lygranthæcia intrabilis (Smith).
mortua (Grote).
saturata—Schinia.
Lythrodes discistriga—Hoplolythra.
Mamestra albogutta—Polia.
anetis—Lasionycta.
binotata—Trachea.
cinnebarina—Polia stricta.
chartaria—Discestra.
circumcincta—Polia stricta.
comis—Polia olivacea.
crotchii—Polia.
cuneata—Polia.
davena—Polia olivacea.
defessa—Scotogramma.
dimmocki—Polia radix.
discalis—Polia.
insolens—Polia.
insulsa—*Euxoa* messoria.
invalida—Polia.
laudabilis—Polia.
lepidula—Polia.
leucogramma—Polia.
minorata—Epia.
nevadæ—Polia.
niveiguttata—Hyssia.
noverca—Polia.
olivacea—Polia.
passa—Polia.
pensilis—Polia.
puerilis—Eriopyge.
punctigera—Euxoa.
quadrata—Polia.
quadrilineata—Polia.
radix—Polia.
rectilinea—Polia olivacea.
rubrica—Xylomania.
septentrionalis—Euxoa.
stricta—Polia.
subapicalis—Xylomania perlubens.
trifolii—Scotogramma.
u-scripta—Trichoclea.
vetusta—Euxoa.
vicina—Polia.
Melanoporphyria prorupta Grote.
Melichleptria californiensis—Heliothis sueta.
celeris—Heliothis.
fasciata—Heliothodes.
oregonica—Dysocnemis.
græfiana—Heliothis.
perminuta—Pseudotamilia.
prorupta—Melanoporphyria.
pulchripennis—Heliothis.
sueta—Heliothis.
vacciniæ—Heliothis.
villosa—Heliothis.
Meliopotis *bolina*—jucunda.
cinis—jucunda.
hadeniformis—jucunda.
jucunda (Hübn.).
Merolonche lupina (Grote).
ursina S-D.
spinea (Grote).
Metalepsis cornuta (Grote).
Microhelia restrictalis (Smith).
Monima addenda (Smith).
arthrolita (Harv.).
mys (Dyar).
pacifica (Harv.).
Monophana februalis (Grote).
Morrisonia confusa (Hübn.).
peractua Morr.
Mythimna blanda (Grote).
Namangana alfceni (Grote).
leucorena (Smith).
Nephelodes mimians Guen.
Nocloa nesæa (Smith).
rivulosa Smith.
Noctua *armigera*—Chloridia.
albovenosa—Arsilonche.
clemens—Agrotis.
gamma—Autographa.
havilæ—Agrotis.
lucipara—Euplexia.
lubricans—Lycophotia.
margaritosa—Lycophotia.
nictitans—Apamea.
oblata—Agrotis.
odora—Erebus.
pallens—Leucania.
pallidicornis—Agrotis cinnereicollis pyrophiloides Harv.
rosaria—Agrotis.
saucia—Peridromia.
virescens—Chloridea.
sierræ—Agrotis.
Nonagria alameda—Archenaria.
Ochria sauzælitæ Grote.
Oligia lævigata (Smith).
violacea (Grote).
Omia nesæa—Nocloa.
Oncocnemis albifasciatus Ham.
aqualis Grote.
aterrima—Pseudocontia.
angustata Harv.
behrensi—Lepipolis.
chorda (Grote).
corusca Smith.
exemplaris (Smith).
fasciatus—albifasciatus.
figurata Ham.
fortis—Homoncocnemis.
fragmantis Smith.
gracillinea—Oxycnemis.
hayesi Grote.
major Grote.
menantho Smith.
mirificalis Grote.
oblita—Cerapoda.
occata (Grote).
pophono Smith.
Orrhodia californica—Homoglæa.
irrorata—Eriopyge.
Orthodes puerilis—Eriopyge.
Orthosia bicolorago—Amathes.
fornica—Amathes.

Orthosia hamifera — Perigrapha transparens.
posticata—Luperina.
purpurea—Amathes.
Oxycnesis fusimacula (Smith).
gracillinea (Grote).
yuma—gracillinea.
Pachnobia cinerascens (Smith).
cornuta—Metalepsis.
Pæctes cristatrix (Guen.).
declinata (Grote).
Palada scarletina Smith.
Panthea portlandia Grote.
Panchrysa palligera (Grote).
Papaipema angelica (Smith).
Paragrotis (Euxoa).
Parastichtis albina (Grote).
antennata (Smith).
arctica (Boisd.).
castanea (Grote).
cuculliformis (Grote).
genialis (Grote).
occidens (Grote).
relicina (Morr.).
Phoberia indiscreta (Edw.).
Peridromia demutabilis (Smith).
incivis (Guen.).
saucia (Hübn.).
Perigea *alfkenii*—Namangana.
falsa—Bryomima.
mersa (Morr.).
Perigonica angulata Smith.
tertia Dyer.
Perigrapha *behrensiana*—Xylomania.
inferior—Stretchia.
muricina (Oregon).
normalis (Grote).
pectinata (Smith).
præses (Grote).
prima Smith.
pulchella Harv.
terminata (Smith).
transparens (Grote).
Phæcocyma salacis (Behr.).
rosæ—salacis.
rubi (Edw.).
Phalæna devastatrix—Sidemia.
ilia—Catocala.
Phoberia indiscreta (Edw.).
Phobolosia resincarineta Dyar.
Pleonectopoda—Euxoa.
Pleonectyptera finitima Smith.
incusalis Grote.
secundatis Grote.
subflavidalis Grote.
Pleroma cinerea Smith.
Pleroma obliquata Smith.
Pleuronectyptera finitima Smith.
Plusia *brassica*—Autographa.
californica—Autographa gamma.
gamma—Autographa.
labrosa—Autographa.
lenzi—metallica.
metallica Grote.
ou—Autographa.
russea—Autographa gamma.
Podagra crassipes Smith.
Polia alboguttata (Grote).
canites Ham.
crotchii (Grote).
cuneata (Smith).
densa (Smith).
discalis (Grote).
insolens (Grote).
invalida (Smith).
laudabilis (Guen.).
lepidula (Smith).
leucogramma (Grote).
maxima—Andropolia.
nevadæ (Grote).
noverica (Grote).
olivacea (Morr.).
olorina—Andropolia.
passa (Morr.).
pensilis (Grote).
privata—Anytus.
quadrata (Smith).
quadrilinea (Grote).
radix (Walk.).
stenotis Ham.
stricta (Walk.).
theodori—Andropolia.
vicina (Grote).
Polia olorina (Grote).
theodori (Grote).
Porosagratis catenula (Grote).
milleri Feltia.
mimallonis (Grote).
Pronoctua pyrophiloides Harv.
Prodenia ornithogali Guen.
præfica Grote.
Protophana cervina (Edw.).
Proxenus miranda (Grote).
Psectraglæa olivata (Harv.).
Pseudocontia aterrima (Grote).
Pseudoglæa blanda—Mythimna.
Pseudoglossa decepta—Mythimna blanda.
Pseudoglossa lubricalis—Epizeuxis.
Pseudorthosia variabilis Grote.
Pseudotamila perminuta Edw.
vanella Grote.
Pyrocleptria californica Ham.
Pyrophila glabella—Amphipyra.
Pyrrhia umbria Hübn.
Rancora matricaria — Cucullia serraticornis.
solidaginis—Cucullia.
Raphia cinderella Smith.
coloradensis Put.
pallula—coloradensis.
Rhizagrotis abnormis (Smith).
lagena (Grote).
Rhodosia julia—Timora.
Rhynchagrotis (Triphæna).
Rhynchagrotis carissima (Harv.).
costata (Grote).
crenulata (Smith).
cupidissima (Grote).
exsertistigma (Morr.).
formalis (Grote).
inelegans (Smith).
lætula (Grote).

Rhynchagrotis rufipectus (Morr.).
trigona Smith.
variata Grote.
Schinia arctifera Guen.
buta Smith.
cupes (Grote).
intrabilis—Lygranthœcia.
lanul Str.
ligeæ—Thyreion.
ochreifuscia—lanul.
packardii—Lygranthœcia mortua.
saturata (Grote).
velaris—lanul.
Scoliopteryx libatrix (Linn.).
Scopelosoma napæa—Litholomia.
Scotogramma defessa (Grote).
densa—Polia.
trifolii (Rott.).
Segetia mersa—Perigea.
Setagrotis dernarius Smith.
infimatis—Anomogyna.
radiatus—Lycophotia radiola.
Sidemia devastatrix Brace.
Simyra henrici (Grote).
Spragueia fumata—Tarachidia.
vernalis—Anomogyna.
Stibadium fulignosa Stiria.
hutsoni—Stiria.
Stiria fulignosa (Smith).
hutsoni (Smith).
Stretchia addenda—Monima.
behrensiana—Xylomania.
erythrolita—Xylomania.
inferior (Smith).
normalis—Perigrapha.
mys—Monima.
plusiiformis (Colorado).
pulchella—Perigrapha.
transparens—Perigrapha.
Stylopoda cephalica Smith.
Symphistis kelloggi (Edw.).
propius Edw.
Synedoida biformata—Cissura.
scrupulosa—Cissura.
subtermina—Cissura.
Syneda adumbrata Behr.
divergens Behr.
edwardsii Behr.
hadeniformis—Melipotis jucunda.
hastingsii Edw.
howlandii Grote.
maculosa Behr.
mexicana—Cirrhobolina.
nubicola Behr.
ochracea Behr.
perpallida—hastingsii.
socia Behr.
stretchii—howlandii.
tejonica Behr.
Tæniocampa addenda—Monima.
arthrolita—Graphiphora.
carina—Polia insolens.
curtica—Eriopyge.
furfurata—Eriopyge affurata.
pacifica—Monima.
Tænicampi paviæ—Trachea.
pectinata—Perigrapha.
perbrunea—Eriopyge.
præses—Perigrapha.
puerilis—Eriopyge.
pulchella—Perigrapha.
rufula—Eriopyge.
terminata—Perigrapha.
Tamila vanella—Pseudotamila.
velaris—Schinia lanul.
Tarache *angustipennis*—Conacontia.
acerba (Edw.).
areli (Stretch).
behrii (Smith).
candefacta—Tarachidia.
coquilletti (Smith).
elegantula—Conochares.
flavipennis (Grote).
gonella (Stretch).
lucasi (Smith).
niveicollis Smith.
semiopaca—Conochares elegantula.
Tarachidia candefacta (Hübn.).
fumata (Smith).
tortricina (Zell.).
Tetanolita palligera (Smith).
Thalpocharea arizonæ—Conochares elegantula.
elegantula—Conochares.
daria—Eumestleta.
Therasea angustipennis—Conacontia.
Thyreion ligeæ (Smith).
Timora julia (Grote).
Tornacontia altera—Conochares.
Tornacontia megocula—Græperia.
Trachea adnixa (Grote).
binotata (Walk.).
catalina (Smith).
centralis (Smith).
cinefacta (Grote).
divesta (Grote).
ethnica (Smith).
fumeola Ham.
genetrix (Grote).
indirecta (Grote).
marina (Grote).
mustelina (Smith).
pausis (Smith).
paviæ (Behr.).
tusa (Grote).
Trichoclea antica Smith.
edwardsii Smith.
postica (Colorado).
u-scripta (Smith).
Tricholita fistula—Chabulata.
Trichosellus cupes Grote.
Trichotarche assimilis Grote.
Triocnemis saporis Grote.
Triphæna carissima (Harv.).
costata (Grote).
crenulata (Smith).
cupidissima (Grote).
discoidalis (Grote).
erratica (Smith).
exsertistigma (Morr.).

Triphæna formalis (Grote).
inelegans (Smith).
lætula (Grote).
meta (Smith).
rufipectus (Morr.).
variata (Grote).
Tristyla alboplagiata Grote.
Ufeus plicatus Grote.
sagittarius Grote.
Ulolonche niveiguttata—Hyssia.
Veleria opina Grote.
Xanthia *bicolorago*—Amathes.
palæcea Esp.
Xanthothrix neumœgeni Edw.
ranunculi Edw.
Xylina amanda Smith.
carbonaria (Harv.).
contenta—Graptolitha.
dilatocula—Graptolitha.
gausapata—Graptolitha.
holocinera Smith.
indeterminata—Eurois.
infructosa—Morrisonia confusa.
oregonensis—Graptolitha.
puella—Graptolitha.
torrida Smith.
Xylomania behrensiana (Grote).
curialis (Grote).
Xylomania erithrolita (Grote).
hiemalis (Grote).
patalis (Grote).
perlubens (Grote).
rubrica (Harv.).
simplex (Walk.).
Xylomiges cruciales—Xylomania simplex.
curialis—Xylomania.
hiemalis—Xylomania.
ochracea—Lasionycta.
patalis—Xylomania.
perlubens—Xylomania.
rubrica—Xylomania.
simplex—Xylomania.
Xylomœa didonea (Smith).
Xylophasia albina—Parastichtis.
antennata—Parastichtis.
centralis—Trachea.
cinefacta—Trachea.
cogitata—Agroperina.
cuculiformis—Parastichtis.
genialis—Parastichtis.
occidens—Parastichtis.
pluviosa—Parastichtis arctica.
Yrias crudelis Grote.
Zosteropoda hirtipes Grote.
Zotheca tranquila Grote.
viridula—tranquila.

GENERAL NOTES.

NATIONAL QUARANTINE LAW.

An act to regulate the importation of nursery stock, and other plants and plant products; to enable the Secretary of Agriculture to establish and maintain quarantine districts for plant diseases and insect pests; to permit and regulate the movement of fruits, plants, and vegetables therefrom, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be unlawful for any person to import or offer for entry into the United States any nursery stock unless and until a permit shall have been issued therefor by the Secretary of Agriculture, under such conditions and regulations as the said Secretary of Agriculture may prescribe, and unless such nursery stock shall be accompanied by a certificate of inspection, in manner and form as required by the Secretary of Agriculture, of the proper official of the country from which the importation is made, to the effect that the stock has been thoroughly inspected and is believed to be free from injurious plant diseases and insect pests; *provided,* that the Secretary of Agriculture shall issue the permit for any particular importation of nursery stock when the conditions and regulations as prescribed in this act shall have been compiled with; *provided further,* that nursery stock may be imported for experimental or scientific purposes by the Department of Agriculture upon such conditions and under such regulations as the said Secretary of Agriculture may prescribe; *and provided further,* that nursery stock imported from countries where no official system of inspection for such stock is maintained may be admitted upon such conditions and under such regulations as the Secretary of Agriculture may prescribe.

SEC. 2. That it shall be the duty of the Secretary of the Treasury promptly to notify the Secretary of Agriculture of the arrival of any nursery stock at port of entry; that the person receiving such stock at port of entry shall, immediately upon entry and before such stock is delivered for shipment or removed from the port of entry, advise the Secretary of Agriculture or, at his direction, the proper state, territorial, or district official of the state or territory or the district to which such nursery stock is destined, or both, as the Secretary of Agriculture may elect, of the name and address of the consignee, the nature and quantity of the stock it is proposed to ship, and the country and locality where the same was grown. That no person shall ship or offer for shipment from one state or territory or district of the United States into any other state or territory or district, any nursery stock imported into the United States without notifying the Secretary of Agriculture or, at his direction, the proper state, territorial, or district

official of the state or territory or district to which such nursery stock is destined, or both, as the Secretary of Agriculture may elect, immediately upon the delivery of the said stock for shipment, of the name and address of the consignee, of the nature and quantity of stock it is proposed to ship, and the country and locality where the same was grown, unless and until such imported stock has been inspected by the proper official of a state, territory, or district of the United States.

SEC. 3. That no person shall import or offer for entry into the United States any nursery stock unless the case, box, package, crate, bale, or bundle thereof shall be plainly and correctly marked to show the general nature and quantity of the contents, the country and locality where the same was grown, the name and address of the shipper, owner, or person shipping or forwarding the same, and the name and address of the consignee.

SEC. 4. That no person shall ship, or deliver for shipment from one state or territory or district of the United States into any other state or territory or district any such imported nursery stock the case, box, package, crate, bale, or bundle whereof is not plainly marked so as to show the general nature and quantity of the contents, the name and address of the consignee, and the country and locality where such stock was grown, unless and until such imported stock has been inspected by the proper official of a state, territory, or district of the United States.

SEC. 5. That whenever the Secretary of Agriculture shall determine that the unrestricted importation of any plants, fruits, vegetables, roots, bulbs, seeds, or other plant products not included by the term "nursery stock" as defined in section six of this act may result in the entry into the United States or any of its territories or districts of injurious plant diseases or insect pests, he shall promulgate his determination, specifying the class of plants and plant products the importation of which shall be restricted and the country and locality where they are grown, and thereafter, and until such promulgation is withdrawn, such plants and plant products imported or offered for import into the United States or any of its territories or districts shall be subject to all the provisions of the foregoing sections of this act: *provided*, that before the Secretary of Agriculture shall promulgate his determination that the unrestricted importation of any plants, fruits, vegetables, roots, bulbs, seeds, or other plant products not included by the term "nursery stock" as defined in section six of this act may result in the entry into the United States or any of its territories or districts of injurious plant diseases or insect pests he shall, after due notice, give a public hearing, under such rules and regulations as he shall prescribe, at which hearing any interested party may appear and be heard, either in person or by attorney.

SEC. 6. That for the purpose of this act the term "nursery stock" shall include all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for

propagation, except field, vegetable, and flower seeds, bedding plants, and other herbaceous plants, bulbs, and roots.

SEC. 7. That whenever, in order to prevent the introduction into the United States of any tree, plant, or fruit disease or of any injurious insect, new to or not theretofore widely prevalent or distributed within and throughout the United States, the Secretary of Agriculture shall determine that it is necessary to forbid the importation into the United States of any class of nursery stock or of any other class of plants, fruits, vegetables, roots, bulbs, seeds, or other plant products from a country or locality where such disease or insect infestation exists, he shall promulgate such determination, specifying the country and locality and the class of nursery stock or other class of plants, fruits, vegetables, roots, bulbs, seeds, or other plant products which, in his opinion, should be excluded. Following the promulgation of such determination by the Secretary of Agriculture, and until the withdrawal of the said promulgation by him, the importation of the class of nursery stock or of other class of plants, fruits, vegetables, roots, bulbs, seeds, or other plant products specified in the said promulgation from the country and locality therein named, regardless of the use for which the same is intended, is hereby prohibited; and until the withdrawal of the said promulgation by the Secretary of Agriculture, and notwithstanding that such class of nursery stock, or other class of plants, fruits, vegetables, roots, bulbs, seeds, or other plant products be accompanied by a certificate of inspection from the country of importation, no person shall import or offer for entry into the United States from any country or locality specified in such promulgation, any of the class of nursery stock or of other class of plants, fruits, vegetables, roots, bulbs, seeds, or other plant products named therein, regardless of the use for which the same is intended; *provided,* that before the Secretary of Agriculture shall promulgate his determination that it is necessary to forbid the importation into the United States of the articles named in this section he shall, after due notice to interested parties, give a public hearing, under such rules and regulations as he shall prescribe, at which hearing any interested party may appear and be heard, either in person or by attorney; *provided further,* that the quarantine provisions of this section, as applying to the white-pine blister rust, potato wart, and the Mediterranean fruit fly, shall become and be effective upon the passage of this act.

SEC. 8. That the Secretary of Agriculture is authorized and directed to quarantine any state, territory, or district of the United States, or any portion thereof, when he shall determine the fact that a dangerous plant disease or insect infestation, new to or not theretofore widely prevalent or distributed within and throughout the United States, exists in such state or territory or district; and the Secretary of Agriculture is directed to give notice of the establishment of such quarantine to common carriers doing business in or through such quarantined area, and shall publish in such newspapers in the quaran-

tined area as he shall select notice of the establishment of quarantine. That no person shall ship or offer for shipment to any common carrier nor shall any common carrier receive for transportation or transport, nor shall any person carry or transport from any quarantined state or territory or district of the United States, or from any quarantined portion thereof, into or through any other state or territory or district, any class of nursery stock or any other class of plants, fruits, vegetables, roots, bulbs, seeds, or other plant products specified in the notice of quarantine except as hereinafter provided. That it shall be unlawful to move, or allow to be moved, any class of nursery stock or any other class of plants, fruits, vegetables, roots, bulbs, seeds, or other plant products specified in the notice of quarantine hereinbefore provided, and regardless of the use for which the same is intended, from any quarantined state or territory or district of the United States, or quarantined portion thereof, into or through any other state or territory or district, in manner or method or under conditions other than those prescribed by the Secretary of Agriculture. That it shall be the duty of the Secretary of Agriculture to make and promulgate rules and regulations which shall permit and govern the inspection, disinfection, certification, and method and manner of delivery and shipment of the class of nursery stock or of any other class of plants, fruits, vegetables, roots, bulbs, seeds, or other plant products specified in the notice of quarantine hereinbefore provided, and regardless of the use for which the same is intended, from a quarantined state or territory or district of the United States, or quarantined portion thereof, into or through any other state or territory or district; and the Secretary of Agriculture shall give notice of such rules and regulations as hereinbefore provided in this section for the notice of the establishment of quarantine; *provided*, that before the Secretary of Agriculture shall promulgate his determination that it is necessary to quarantine any state, territory, or district of the United States, or portion thereof, under the authority given in this section, he shall, after due notice to interested parties, give a public hearing under such rules and regulations as he shall prescribe, at which hearing any interested party may appear and be heard, either in person or by attorney.

SEC. 9. That the Secretary of Agriculture shall make and promulgate such rules and regulations as may be necessary for carrying out the purposes of this act.

SEC. 10. That any person who shall violate any of the provisions of this act, or who shall forge, counterfeit, alter, deface, or destroy any certificate provided for in this act or in the regulations of the Secretary of Agriculture, shall be deemed guilty of a misdemeanor and shall, upon conviction thereof, be punished by a fine not exceeding five hundred dollars or by imprisonment not exceeding one year, or both such fine and imprisonment, in the discretion of the court; *provided*, that no common carrier shall be deemed to have violated the provisions of any of the foregoing sections of this act on proof

that such carrier did not knowingly receive for transportation or transport nursery stock or other plants or plant products as such from one state, territory, or district of the United States into or through any other state, territory, or district; and it shall be the duty of the United States attorneys diligently to prosecute any violations of this act which are brought to their attention by the Secretary of Agriculture or which come to their notice by other means.

SEC. 11. That the word "person" as used in this act shall be construed to import both the plural and the singular, as the case demands, and shall include corporations, companies, societies, and associations. When construing and enforcing the provisions of this act, the act, omission, or failure of any officer, agent, or other person acting for or employed by any corporation, company, society, or association, within the scope of his employment or office, shall in every case be also deemed to be the act, omission, or failure of such corporation, company, society, or association as well as that of the person.

SEC. 12. That for the purpose of carrying out the provisions of this act there shall be appointed by the Secretary of Agriculture from existing bureaus and offices in the Department of Agriculture, including the Bureau of Entomology, the Bureau of Plant Industry, and the Forest Service, a Federal Horticultural Board consisting of five members, of whom not more than two shall be appointed from any one bureau or office, and who shall serve without additional compensation.

SEC. 13. That there is hereby appropriated, out of the moneys in the treasury not otherwise appropriated, to be expended as the Secretary of Agriculture may direct, for the purposes and objects of this act, the sum of twenty-five thousand dollars.

SEC. 14. That this act shall become and be effective from and after the first day of October, nineteen hundred and twelve, except as herein otherwise provided.

Approved, August 20, 1912.

LASSEN COUNTY.

Lassen County is possessed of a very superior soil, and has an altitude favorable for the very finest apples, pears, cherries and apricots. Apples especially are of very superior flavor and coloration in these higher districts. Their superiority will ever find for them a market. Alfalfa is another crop that does exceptionally well in this county.

The orchards of the county are now suffering from die-back, and are infested with many of our worst insect pests, such as codling moth, wooly aphis, green and purple aphis, black peach aphis and the San Jose scale. I take it that no one is to blame for this condition. The want of transportation facilities now assured made all fruit a drug on the market, as there was no demand for it other than the very limited home consumption, and so there was no inducement for people to clean up their trees or to properly cultivate their orchards. It is a great com-

pliment to the soil and natural adaptation of this county to fruit growing that the trees are doing as well as they are in view of the obvious neglect everywhere apparent.

As there are so few trees now it would be cheap and easy to extirpate the insect and fungous pests, while later, with the extensive plantings that are sure to come, it will be expensive and laborious. Again the present conditions of the orchards will deter the best informed fruit growers from coming into the county at all, and so the date of full plantings will be cut off, and the people who do come will not be the ones who will give character to the county.

What is sorely needed is a thoroughly trained, wide-awake county commissioner, who will give his whole time, energy and attention to a thorough clean-up of the orchards already planted. Such an official must stand a thorough examination at the hands of the State Examining Board, which insures the requisite training, and the appointing board — the supervisors of the county — can assure themselves that the appointee has the needed energy and traits called for in a first class county commissioner.

The law makes it easy to secure this action: twenty-five bona fide fruit growers and land owners petition the supervisors for a county commissioner, stating that their orchards are infested with serious insect and fungoid pests. The supervisors then must ask of the State Board of Examiners an examination, which will be held in the county, and the board will then inform the supervisors of those that have passed and are eligible for the office, from which the supervisors must appoint a county commissioner.

Some will wonder if it will pay to do this. The experience of most all the counties of the State has abundantly proved that it is wise and does pay many times the salary of the commissioner. Two counties, Humboldt and Inyo, have recently acted and are very pleased with the results.

Lassen County is soon to become one of the extensive alfalfa fields of California, and one of the great orchard areas of the State. It can not be too soon. Action, such as suggested above, will surely hasten this result.

The great State of California, as well as Lassen County, is keenly alive to the desirability of eradicating the pests already here, and of keeping those not here from coming. A wide-awake county commissioner will help powerfully in surely and quickly bringing this about.

A. J. Cook.

QUARANTINE ORDER NO. 14.

August 13, 1912.

Whereas, the alfalfa fields of the following counties of Utah: Salt Lake, Tooele, Juap, Utah, Wasatch, Summitt, Davis, Morgan, Weber, Boxelder, Cache and Rich: of the two counties of Idaho: Oneida and Bear Lake: and of Uintah County in the State of Wyoming are infested with the alfalfa weevil (*Phytonomus posticus*); and

WHEREAS, the devastation of this insect is very serious, often ruining the entire crop; and

WHEREAS, our alfalfa product is very important, the estimated cash value the present year being a little short of $50,000,000; and

WHEREAS, there is danger of our receiving this pest through the importation of alfalfa hay from the counties aforesaid, as determined by the chief deputy of this Commission, who has visited and thoroughly studied the conditions in the devastated area;

Therefore, it is declared that a quarantine be, and the same is hereby, established against all alfalfa hay from the several counties hereinbefore mentioned of Utah, Idaho, and Wyoming. All horticultural commissioners, local inspectors and deputies of the State Horticultural Commission are hereby instructed and required to refuse shipment into the State of California of all alfalfa hay from the said quarantined counties. If such hay is shipped into the State by any oversight, it must at once be destroyed or returned to shipper.

All transportation companies are ordered to refuse for shipment into California any alfalfa hay from the said infested counties.

A. J. COOK,
State Commissioner of Horticulture.

Approved by:
HIRAM W. JOHNSON,
Governor of the State of California.

VALUE OF BIRDS ON THE FARM.

Birds of Prey as Rodent Destroyers.—Probably no class of birds has been more often misjudged or misunderstood than the birds of prey. In fact, the time is not long past when the name hawk or owl was enough to convict any bird. In these days, however, we are beginning to realize that, with a few exceptions, they are "among the most valuable, if not the most valuable, birds that wage war against the foes of the agriculturist." While the smaller birds destroy the insect foes of the farmer, the hawks and owls help to hold in check the small animal life, which, when uncontrolled, works such havoc in the crops.

It has been estimated that every hawk and owl, in the course of a year, kills at least a thousand mice or their equivalent in insects. If each mouse, or its equivalent in insects, caused the farmer a loss of only two cents per annum, this would make each hawk and owl worth at least twenty dollars a year to the farmer.

For convenience we may divide the birds of prey into two general classes, (1) those almost wholly harmful, and (2) those almost wholly beneficial.

In the first class, among the hawks, are the Cooper's, sharp-shinned and duck hawks. The Cooper's and sharp-shinned are very similar in appearance, the latter being simply a "smaller edition" of its larger cousin. These are the two species commonly known as "hen and chicken hawks," being especially destructive in the poultry yard. Aside from the direct loss which they cause the farmer in this way, they also add to this loss by killing great numbers of the useful insect and seed-eating birds. The decrease of certain game birds, in some localities, can also be laid at the door of "these desperadoes in feathers." The duck hawk being found chiefly about large bodies of water, confines its depredations almost entirely to waterfowl, so is of little interest to the farmer.

One practical farmer has suggested that "shelters which will enable chickens to escape from hawks can be easily made by putting forked sticks in the ground and over all a layer of brush, a foot or eighteen inches from the ground."

Among the most common of the beneficial hawks may be placed the marsh hawk, the western red-tailed hawk and the sparrow hawk. While these birds may occasionally invade the poultry yard or destroy birds, the harm done in this way is very little compared with the good which they do in the destruction of injurious rodents and insects.

The following, quoted from Dr. A. K. Fisher of the U. S. Biological Survey, serves to show the economic value of the marsh hawk: "It is probably the most active and determined foe of meadow mice and ground squirrels, destroying greater numbers of these pests than any other species. * * * It preserves an immense quantity of grain, thousands of fruit trees, and innumerable nests of song-birds, by destroying the vermin which eat the grain, girdle the trees and devour the eggs and young of the birds." The distinguishing mark of this hawk is the large white patch at the base above the tail, which shows very plainly when the bird flies.

The western red-tailed hawk is probably one of the best known of all the hawks. Unfortunately it is often killed under the misleading name of "hen hawk." Only about seven per cent of the food of this hawk is chicken, while sixty-six per cent of it consists of ground squirrels, mice and other injurious rodents, which places the bird decidedly among the farmer's friends. The ground squirrel not only preys on the crops, but is a chicken thief as well, and is so sly that it often carries on its work entirely unnoticed.

While most of the hawks are especially useful as rodent destroyers, some of them feed largely on insects. One of these is the little sparrow hawk, its food being chiefly such insects as grasshoppers and crickets. At certain seasons it also feeds largely on mice and other small animals. The sparrow hawk is often confused with the sharp-shinned hawk. It may be distinguished by the lighter color and black markings on head, by its habit of hovering in the air, and also by the fact that it is found out in the open, often on telephone poles, while the sharp-shinned usually remains hidden until ready to dart out after its prey.

Another bird very similar to the sparrow hawk in its food habits is the California shrike or "butcher bird" as it is commonly called. Although this bird is placed on the black list because of its habit of destroying birds, in an examination of 124 stomachs only two birds were found. On the other hand, the injurious animals eaten far outnumber the birds, while about eighty-three per cent of its food for the year is insects. According to Mr. Grinnell of the University of California, "as it is such a persistent destroyer of the Jerusalem cricket and other injurious insects, it is undoubtedly one of the most beneficial birds from the agriculturist's standpoint."

Space prevents the discussion of the food habits of other hawks to be

found in the State, but suffice it to say, that the farmer who protects all members of this family, with the exception of the harmful species named, will get more than "value received," by seeing a marked decrease in the rodent pests on his farm.

California Fish and Game Commission.

STATE FRUIT GROWERS' CONVENTION AT FRESNO, CALIFORNIA.

December 11, 12 and 13, 1912.

The forty-second California State Fruit Growers' Convention, under the auspices of the State Commissioner of Horticulture, will be held at Fresno, Wednesday, Thursday and Friday, the 11th, 12th and 13th of December, 1912. As in the past the State Commissioner of Horticulture will endeavor to make this convention as practical and helpful as possible, not only to the growers of the immediate vicinity but to those of the entire state. In view of the fact that the San Joaquin Valley is a great grape producing section, one entire day will be given over to viticulture. Frank T. Swett, Horticultural Commissioner of Contra Costa County, will have charge of this day.

One half day of the convention will be devoted to a trip through the surrounding territory, with a view of ascertaining the conditions and methods of horticulture at first hand. On each evening there will be a stereopticon lecture.

It is my belief that there has been a tendency to overcrowd conventions, and we are desirous of preventing this at the coming meeting. There will be fewer papers and more discussion, with a greater allowance of freedom.

While the programme is not yet perfect, the following speakers are assured:

The Grapevine Hopper, by Prof. H. J. Quayle, Berkeley, Cal.

The Citrus Red Spider, by W. H. Volck, Watsonville, Cal.

Lecture, by T. F. Hunt, new dean of the Experiment Station at Berkeley, Cal.

Phylloxera of the Grapes and Resistant Vines, by Frank T. Swett, Martinez, Cal.

Prune Culture, by E. N. Richmond, San Jose, Cal.

Cultivation and Subsoil, by A. J. Cook, State Commissioner of Horticulture, Sacramento, Cal.

Citrus Culture in Europe, stereopticon lecture by G. Harold Powell, Los Angeles, Cal.

Quarantine, stereopticon lecture by Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco, Cal.

Details in Citrus Culture, by C. C. Chapman, Fullerton, Cal.

Stereopticon Lecture, by H. F. Stoll, Secretary Grape Growers' Association, San Francisco, Cal.

Lectures on Viticulture, by Prof. F. T. Bioletti, of the University of California, Berkeley, Cal., and George Hecke, Woodland, Cal.

With the exception of the stereopticon lectures, the evenings of the convention will be placed in the hands of the county commissioners to use as they see fit.

E. O. ESSIG.

HORTICULTURAL ORDINANCES OF LOS ANGELES COUNTY NOT APPEARING IN THE HORTICULTURAL STATUTES RECENTLY ISSUED BY THE STATE COMMISSIONER OF HORTICULTURE.

Weeds.

Ordinance No. 39 (new series) on weeds, passed May 27, 1901; took effect June 15, 1901.

An ordinance to prevent the propagation and provide for the suppression of the Scotch or Canada thistle, Russian thistle, Mexican cocklebur and other noxious weeds.

The board of supervisors of the county of Los Angeles, State of California, do ordain as follows:

SECTION 1. It shall be unlawful for any person owning or possessing land in the county of Los Angeles to permit the Scotch or Canada thistle, the Russian thistle, Mexican cocklebur, or any noxious weed to mature or disseminate its seed on the land so owned or possessed by such person.

SEC. 2. It shall be unlawful for any person to sow or disseminate, or to permit the sowing or disseminating of any seed of the Scotch or Canada thistle, the Russian thistle, Mexican cocklebur, or any noxious weed upon any of the land owned or possessed by another.

SEC. 3. It shall be unlawful for any person to sell or in any way dispose of any seed of the Scotch or Canada thistle, the Russian thistle, Mexican cocklebur, or the seed of any noxious weed to another, whether in the packing of goods, or in grain or grass seeds or otherwise.

SEC. 4. Every person who shall violate any of the provisions of this ordinance shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not more than five hundred dollars, or by imprisonment in the county jail for not exceeding six months, or by both such fine and imprisonment.

Transportation of Trees, Plants and Vines Within the County.

Ordinance No. 220 (new series) on transportation of trees, plants, vines, passed October 18, 1909; took effect November 5, 1909.

An ordinance to regulate the transportation of trees, plants and vines within the County of Los Angeles.

The board of supervisors of the county of Los Angeles do ordain as follows:

SECTION 1. No person, firm, or corporation shall ship, transport, carry or convey any trees, plants, vines, shrubs, scions, cuttings, buds or grafts from one place to another in the county of Los Angeles without first giving notice of such intended transportation to the local horticultural inspector of the district in which such articles are situated, nor until such local inspector shall have inspected such trees, plants, vines, shrubs, scions, cuttings, buds or grafts, and shall have found and certified that the same are free from scale and other insect pests injurious to trees, plants, vines, fruits or vegetables. It shall be the duty of every local inspector to make such inspection as soon as convenient after receiving such notice.

SEC. 2. If upon examination said local inspector finds such trees, plants, vines, shrubs, scions, cuttings, buds or grafts, or any thereof, to be infested with scale or other insect pests injurious to trees, plants, vines, fruits or vegetables, said trees or other articles, shall without removal be at once fumigated or otherwise disinfected by the owner thereof in such manner as said local inspector shall direct. Said trees or other articles shall not be removed from the place where the same were inspected during a period of six months after such fumigation or disinfection, nor thereafter until such local inspector shall have inspected the same again and found and certified in writing that the same are free from scale and other insect pests above mentioned.

SEC. 3. No person, firm or corporation shall ship, transport, carry or convey any trees, plants, vines, shrubs, scions, cuttings, buds or grafts from one locality or neighborhood in the county of Los Angeles that is infested with any kind of scale or other insect pest hereinabove mentioned, to any other locality or neighborhood that is not infested with the same kind of scale or other insect pest.

SEC. 4. Any person deeming himself aggrieved by any of the acts or decisions of the local inspector under this ordinance may appeal to the horticultural commissioner and his decision in the matter shall be final.

SEC. 5. Any person, firm or corporation violating any of the provisions of this ordinance shall be deemed guilty of a misdemeanor and upon conviction thereof shall be punishable by a fine of not more than five hundred dollars, or by imprisonment in the county jail for a period of not more than six months, or by both such fine and imprisonment.

Spraying and Fumigating Trees.

Ordinance No. 245 (new series) of licenses and police regulations, passed August 30, 1910; took effect October 1, 1910.

An ordinance regulating and licensing certain kinds of business in the county of Los Angeles.

The board of supervisors of the county of Los Angeles do enact as follows:

SECTION 53. Every person who engages in, conducts or carries on the business of spraying or the business of fumigating trees, plants, vines or orchards, shall pay a license fee of three dollars per quarter.

SEC. 54. No license shall be issued under section 53 hereof except upon a written permit from the board of supervisors. Said board shall, upon application being made to them for any such permit, direct the horticultural commissioner to examine the applicant and the implements and apparatus to be used by him in such business, and report the result to said board, and shall grant such permit only if it finds that the applicant understands the proper conduct of such business and is competent to engage therein, and that the said implements and apparatus are properly constructed and suitable for said business. Whenever any person holding such permit does, or causes to be done, any spraying or fumigating in a negligent or unskillful manner, or uses therefor improper materials or an insufficient quantity thereof, or unfit or improperly constructed apparatus or implements, said board of supervisors may, upon notice to such person, and after hearing him upon the matter, revoke any permit granted to him under this ordinance, and after such revocation no further license shall be issued to him without a new permit. All such permits and written notice of all such revocations shall be filed with the tax and license collector. For the purposes of this ordinance every person who has charge of or directs the operations of any outfit of apparatus or implements used in the business of spraying or the business of fumigating trees, plants, vines or orchards, or who applies thereto or prepares, the chemicals used in such fumigation, whether on his own account or as agent of another, shall be deemed to be engaged in such business, and shall be required to have a license therefor.

SEC. 55. Any person holding a license under section 53 hereof shall on demand of the horticultural commissioner submit to said commissioner a correct statement of the kinds and amounts of chemicals or other materials used, or to be used, by such person in spraying or fumigating any trees, plants, vines, or orchards. Every person holding such a license shall report to the horticultural commissioner in writing at the end of each month the number and location of trees, plants, or vines sprayed or fumigated by him during such month, the nature of the pests with which the same were infected, the name of the owner thereof and the treatment given thereto.

GRAVENSTEIN APPLE SHOW AT SEBASTOPOL.

There are many substantial benefits that come from a thoroughly admirable exhibit of agricultural products.

The first, and not the least in real value, is the financial gain which is sure to be secured. I was told at Sebastopol last week that the two previous exhibits of Gravenstein apples had netted a million to the people of the city and the surrounding country. The rise of real estate is not all, for such a magnificent exhibition attracts wide attention and secures as citizens many of the finest and most enterprising people of the country.

Again, such a massing of superior fruits graphically illustrates and demonstrates the possibilities of a district as nothing else can. The marvelous display of fruits of so many varieties, of nuts and vegetables, made every visitor from abroad wish that he belonged to so goodly and fruitful a region. The various displays, fashioned from green and dried fruits, were most ingenious and enlisted great admiration and praise. Among many others was the old Dutch windmill. A Dutchman, on seeing this, exclaimed: "Mein Gott, and there is the puddle, too." The hard work, thought and study called for in fashioning these designs required no little sacrifice, all to please and benefit others, and must ennoble those who make the sacrifice.

The superiority of the fruit, especially the almost entire freedom of any show of insect or fungoid attack, not only speak volumes for the excellent cultivation by the ranchers, but are also loud in praise of County Commissioner Gallaway, whose excellent practical work made this fine display possible. His collection of insects and fungi was very attractive and instructive, and was the center of a group of interested spectators, who were alert to learn all about these pests of the orchard. The throngs in attendance by day and in the evenings proved the value of such exhibits. The educative and social uplift from this splendid exhibition is most commendable, and will certainly influence the managers to continue these displays with ever-increasing attractiveness. Once seen, no one will think of missing such another exposition.

A. J. Cook.

NOTES FROM THE COUNTY COMMISSIONERS.

By G. E. Merrill.

Humboldt. Commissioner Weatherby is making an attempt to eradicate the codling moth in the Mattole district, a promising apple section of his county.

Sacramento. Commissioner Bloomer has just returned from a visit to Washington, D. C. While there he interested himself in the passage of the National Quarantine bill.

San Joaquin. Commissioner Garden was a recent visitor at Sacramento.

Shasta. The red spider has been considerably in evidence on prunes this season, but has been well controlled by the use of sulphur. Commissioner Lamiman reports that the prunes in his county have dropped but little and will be of good size.

Sonoma. Commissioner Gallaway and his deputy, Mr. O. E. Bremner, are to be congratulated on the excellence of their exhibit at the Sebastopol apple show. Specimens of the work of the more important injurious insects and plant diseases were shown, together with the work of beneficial insects, and the effects of various remedies. A comprehensive collection of *Coccidæ,* belonging to Mr. Bremner, was also shown. A large show case, with life history studies, from the Insectary Division of the State Commission of Horticulture, was one of the prominent features of the county exhibit.

Tehama. Considerable injury to wine grapevines from an obscure fungous trouble is reported by Commissioner Weeks.

Tulare. Among the out of town visitors to the Sebastopol apple show was Commissioner Schulz, who has been enjoying a vacation about the bay cities.

Yolo. Commissioner Hecke was a recent visitor to this office.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF JUNE, 1912.

By Frederick Maskew.

The past month has been one of great moment to the Horticultural Quarantine service of the State. The advent of Doctor Severin created an effervescence, which, before its final subsidence cleared up the local atmosphere and brought out the cardinal points in the fruit fly situation with a clarity and distinction that is refreshing.

On this new horizon stand out with prominence the contingencies that may govern to a large extent future freight receipts and trade profits. With a celerity that proves their alertness to these matters so vital to business, the executive heads of the steamship lines and the importers of fruit have sensed this new perspective, and are now voluntarily offering their capable coöperation to the quarantine service in an effort to eliminate every questionable avenue of entrance open to the fruit flies.

The fruit growers also are now able to see with much clearness what was obscure to them before. The possibilities of detection by a well organized system that reaches out to every port of entry on the California coast has restored their confidence in the work of the division, and aroused a desire to increase its forces.

The personnel of the permanent committee on Mediterranean fruit fly has inspired in the quarantine officers a feeling that their present efforts to detect and exclude the contraband material will be supported, and their power to proceed still further in the matter of searching for the same will be strengthened to the utmost. All of this makes for a solidarity of purpose and actual effort that augurs well for progress toward the much desired complete exclusion of *trypetid* hosts.

A review of the actual work of this division for the month of June sets forth the following facts:

Every vessel arriving at California points from foreign ports during the past month has been met upon its arrival by a horticultural quarantine officer, excepting only the oil vessels arriving at Port San Luis. The quarantine office has a coöperative agreement with this transportation company whereby the crews of these oil vessels are ordered not to bring any tropical fruits to California under penalty of dismissal.

No fruit or melon flies in any stage of development have been found in any imports arriving during the past month. Contraband material (*trypetid* hosts) arriving from Honolulu has decreased as compared with that of last month. From Mexican points it has increased.

In coöperation with the importers an investigation of the banana problem in San Francisco has been inaugurated, and an inspector specially detailed to collect data with a view to devising a system

covering every phase of handling this material between the ship and the retailer.

Especially constructed insect traps have been established at several points around the bay. In this matter preference of location has been given to areas with a variety of host fruits, and to others looked upon with suspicion. These are visited at regular intervals, the trapped insects collected, washed out, and a list of those taken during the month tabulated as to families and printed in this report. No species of fruit flies were found in any of these traps.

Fresh fruits entering the San Francisco markets from adjacent regions are regularly watched and reported upon, for the purpose of detecting any possible presence of larvæ of the fruit fly. So far no evidence of the presence of this pest has been found

An educational feature of the work of this division for the month has been the preparing of a list of fruits and vegetables attacked by fruit or melon flies on the Hawaiian Islands, also a list of fruits from Mexico and Central America attacked by the Mexican orange maggot. These are to be printed and furnished to the pursers and stewards of all vessels calling at these ports, with an admonition that they are refused admittance to California.

SAN FRANCISCO STATION.

Horticultural imports.		Parcels.
From Honolulu direct	7 ships	
Passed as free from pests		16,616
Fumigated before releasing		1,238
Destroyed		10
Returned		----
Contraband in ship stores or passengers' baggage		8
Total		17,872
From New Zealand, Australia and South Sea Islands	1 ship	
Passed as free from pests		323
Fumigated before releasing		----
Destroyed		2
Returned		----
Contraband in ship stores or passengers' baggage		10
Total		335
From China, Japan and Orient	4 ships	
Passed as free from pests		611
Fumigated before releasing		2
Destroyed		11
Returned		----
Contraband in ship stores or passengers' baggage		8
Total		632
From South and Central American, Mexican and Pacific coast ports	13 ships	
Passed as free from pests		8,139
Fumigated before releasing		----
Destroyed		5
Returned		----
Contraband in ship stores or passengers' baggage		18
Total		8,162

		Parcels.
United States transports from Philippines and Hawaiian Islands	1 ship	
Passed as free from pests		7
Fumigated before releasing		----
Destroyed		----
Returned		----
Contraband in ship stores or passengers' baggage		----
Total		7
By railroads from all points:		
Passed as free from pests		16,270
Fumigated before releasing		----
Destroyed		1
Returned		----
Total		16,271
Parcels post from all points:		
Passed as free from pests		8
Fumigated before releasing		----
Destroyed		1
Returned		----
Total		9

TOTAL FOR THE MONTH OF JUNE, 1912.

Ships	26	
Passed		41,974
Fumigated		1,240
Destroyed		30
Returned		----
Contraband destroyed		44
Total parcels of horticultural products for month		43,288

COLLECTED IN INSECT TRAPS.

Numbers of several species of the following families were taken during the month of June:

Arachnida (spiders)
Psyllidæ (jumping plant lice)
Noctuidæ (moths)
Culicidæ (mosquitoes)
Anthomyidæ (spinach flies)
Drosophilidæ (vinegar flies)
Scarabæidæ (beetles)
Cerambycidæ (beetles)
Ichneumonidæ (parasitic flies)
Pentatomidæ (plant bugs)
Hemerobiidæ (lace wing flies)
Cecidomyidæ (gall gnats)
Syrphidæ (syrphus flies)
Oestridæ (bot flies)
Staphylinidæ (rove beetles)
Chrysomelidæ (leaf eaters)
Coccinellidæ (ladybird beetles)
Apidæ (bees)

No fruit flies of any species were found in the material taken from these traps.

PESTS INTERCEPTED.

From Hawaiian Islands—
Ceroplastes rubens on Leis.
Coccus longulus on Hibiscus.
Hemichionaspis minor on bananas.
Aspidiotus lantaniæ on bananas.
Chrysomphalus aonidum on bananas.
Ischnaspis filliformis on *Asparagus sprengeri.*
Diaspis bromelia and *Pseudococcus* sps. on pineapples.
From Tahiti—
Morganella maskelli on orange.
Lepidosaphes beckii on orange.

From Japan—
Aphis sps. on pine trees.
Parlatoria theæ var. *viridis* on maple.
Saissetia nigra on betel leaves.
Pseudococcus sps. on betel leaves.
Pseudaonidia trilobitiformis on lemon.
From Mexico—
Diaspinæ sps. on cocoanut.
Bruchus limbatus on seeds.
Chrysomphalus scutiformis on limes.
From Singapore—
Parlatoria mangifera on orchid.
From Belgium—
Aspidiotus britannicus on *Laurus* sps.
From England—
Aphis sps. on chrysanthemums.

LOS ANGELES STATION.

Horticultural Imports.	Parcels.
From all foreign ports	5 ships
Passed as free from pests	42
Fumigated	5
Destroyed	----
Returned	----
Contraband in ship stores or passengers' baggage	----
Total	47
From North Pacific ports	14 ships
Passed as free from pests	----
Fumigated	----
Destroyed	----
Returned	----
Total	----
By railroads from United States and foreign points	389
Passed as free from pests	306
Fumigated	41
Destroyed	38
Returned	----
Contraband	4
Total	389

TOTAL FOR THE MONTH OF JUNE, 1912.

Ships	19
Passed as free from pests	348
Fumigated	46
Destroyed	38
Returned	----
Contraband destroyed	4
Total parcels of horticultural products for month	436

PESTS INTERCEPTED.

From Belgium—
Hemichionaspis aspidistræ on palm sps.
Pseudococcus citri on palm sps.
Saissetia hemisphærica on palm sps.
Diaspinæ sps. on palm sps.
From Eastern States—
Chrysomphalus ficus on citrus sps. and palm sps.
Orthezia insignis on palm sps.
Parlatoria pergandii on citrus sps.
Pseudococcus citri on citrus sps. and rose sps.
From England—
Bruchidæ in vetch seed.

SAN DIEGO STATION.

Horticultural imports.		Parcels.
From Mexico	31 ships	
Passed as free from pests		6,143
Fumigated		2
Destroyed		15
Returned		
Contraband in ship stores and passengers' baggage		15
Total		6,164
From other foreign ports	3 ships	
No horticultural products on these vessels.		
From North Pacific ports	6 ships	
No horticultural products on these vessels.		

TOTAL FOR THE MONTH OF JUNE, 1912.

Ships	40	
Passed as free from pests		6,143
Fumigated		2
Destroyed		15
Returned		
Contraband destroyed		15
Total parcels of horticultural products for month		6,164

PESTS INTERCEPTED.

From Mexico—

Chrysomphalus sps. on cocoanut.
Pseudococcus adonidum on cocoanut.
Chrysomphalus aurantii on orange.
Parlatoria pergandii on orange.
Borer in herb root.
Lepidosaphes gloverii on lime.
Monomorium minutum (ant) in box of mixed fruit.

SANTA BARBARA STATION.

From Honolulu direct ---------- 2 ships
No foreign horticultural products on board.

EUREKA STATION.

No foreign vessels arrived at this port during month of June.

QUARANTINE WORK IN SOUTHERN CALIFORNIA.

By A. S. Hoyt.

In looking over the work of the Southern Quarantine Division for the month of June, a marked falling-off in the number of horticultural imports is to be noted. Owing to the fact, however, that seventy-three of the packages which figure in the total for this office were counted as carloads, the volume of horticultural material handled in Los Angeles and the immediate vicinity is considerably larger than the report indicates.

During the month large quantities of ripe fruits, from Mexico and the neighboring states, have entered California at this point. Perishable as this class of material is, prompt attention and immediate action on the part of the quarantine division has been required.

Large shipments of barley, in transit to Liverpool from Mexico, have arrived by rail in San Pedro, there to await a ship bound for England.

Since most of this grain must remain at the port for some time, it has been carefully inspected.

Consignments of valuable, ornamental shrubs, palms, etc., have been received from Belgium and many eastern states This material was handled with all despatch consistent with the safety of the fruit interests of the State and prompt measures were taken, when necessary, to clean up any infested shipments.

From San Diego Mr. E. O. Amundsen, State Quarantine Inspector, reports a busy month. A steady growth in shipping is noticeable at that port, which manifests itself most recently in a new company operating on a weekly schedule from Ensenada, Mexico, to Los Angeles, making its first port of entry in California at San Diego.

REPORT FOR THE MONTH OF JULY, 1912.

By Frederick Maskew.

During the month of July I had an opportunity to visit the southern stations and acquaint myself with the local methods employed in carrying on the quarantine work at these important ports of entry. The principal source of contrabrand material at these points is found in the imports of Mexican fruits that are known to be hosts of the orange maggot, *Anastrepha ludens*. The control of this material is practically complete, due to the perfect coöperation that exists between the agents of the transportation companies and the quarantine officers. This working in unison of these forces is due as much to the diligence of the quarantine officers in making their rounds as in the desire of the agents to comply with the State regulations. Through the ingenuity of A. S. Hoyt, the Los Angeles office has been put in telephonic connection with the marine observer at Point Fermin, and the appearance of all ships from foreign ports bound in for San Pedro is reported in time to enable an inspector to meet them on their arrival at the docks. This factor is proving a time saver as well as a matter of insurance. At the port of San Diego vessels and passengers from various Mexican points are an almost daily occurrence, and while the volume of horticultural imports is small, the nature and intended destination of the same makes the danger of introduction grave, and the necessity of inspection imperative. From what I both saw and learned during my visit, the inspection here is thorough and the standard of cleanliness governing admission is on a high plane. A feature of the work at this point, for which E. O. Amundsen is entitled to much credit, is the educational work being done among all those concerned in the bringing into San Diego of horticultural products from outside the State lines. This continuous proselytism in vogue at all the stations is advancing the permanent progress of quarantine work more than any other one factor in the service.

At the port of San Francisco the horticultural imports are great and varied, but the permanent issue is the material arriving from Honolulu.

During the month of July we intercepted and destroyed forty-eight lots of contraband fruit from Mexico, but found no live fruit flies in any stage of development in the same. During this period we obtained, from vessels arriving from Honolulu, thirty-two different lots of contraband; out of this material we found seven lots infested with live larvæ of the melon fly, *Dacus cucurbitæ*, and five lots infested with live larvæ of the Mediterranean fruit fly, *Ceratitis capitata*. Such items as these are what we must expect to occasionally find in the monthly reports for all time from now on, and are what make the quarantine service imperative. With the arrival of each vessel at San Francisco from infested ports — Mexican as well as Oriental or Oceanic — there is ample evidence that the efforts of the officials of the steamship lines to prevent the bringing in of contraband material are producing results. Considering the number and heterogeneous nature of the crews manning these vessels, this is a herculean task, but we find that the stringent general orders issued from headquarters have finally permeated all grades of subordinates, both afloat and ashore, and the effect is salutary. This is capable coöperation; it is costing these companies lots of money and is worthy of general recognition. All phases of the work, such as the fruit markets, the banana shipments and the fly traps have been kept up and reported upon in detail.

Since taking charge of the quarantine service three months ago I have critically studied the many different lines of the work—especially here at the port of San Francisco — with a view to locating every possible avenue open to entrance, and also to devising a system of inspection that would give to me a more complete control of all horticultural imports seeking admission. During this time I have located several leaks (some very serious ones) in the system, and have promptly stopped them. To keep these permanently closed, constant daily attention is needed. Perfunctoriness is the greatest enemy to thoroughness, and to keep this out of the work I am of the opinion that each inspector's duties should be clearly outlined, and that each be held individually responsible for the control of the section assigned. This specialization of duties will permit of a concentration of thought, should lead to initiative, and make for a desire to excel on the part of each individual.

To this end I submitted a plan of reorganization of the force employed at the San Francisco office with an outline of the proposed new details for the consideration of Dr. A. J. Cook. The plan was promptly accepted, two additional men provided, and we have started with the present month of August for a demonstration of the value of the new policy.

SAN FRANCISCO STATION.

Horticultural imports.		Parcels.
From Honolulu direct	7 ships	
Passed as free from pests		21,327
Fumigated before releasing		1,798
Destroyed		48
Returned		1
Contraband in ship stores or passengers' baggage		6
Total		23,180
From New Zealand, Australia, and South Sea Islands	1 ship	
Passed as free from pests		54
Fumigated before releasing		----
Destroyed		2
Returned		----
Contraband in ship stores or passengers' baggage		----
Total		56
From China, Japan and Orient	5 ships	
Passed as free from pests		536
Fumigated before releasing		----
Destroyed		15
Returned		1
Contraband in ship stores or passengers' baggage		26½
Total		584½
From South and Central American, Mexican and Pacific coast ports	13 ships	
Passed as free from pests		15,260
Fumigated before releasing		----
Destroyed		----
Returned		----
Contraband in ship stores or passengers' baggage		5
Total		15,265
United States transports from Philippines and Hawaiian Islands	2 ships	
Passed as free from pests		6
Fumigated before releasing		1
Destroyed		1
Returned		----
Contraband in ship stores or passengers' baggage		1
Total		9
By railroads from all points:		
Passed as free from pests		1,034
Fumigated before releasing		----
Destroyed		----
Returned		----
Contraband		43
Total		1,077
Parcels post from all points:		
Passed as free from pests		29
Fumigated before releasing		----
Destroyed		----
Returned		----
Total		29

TOTAL FOR THE MONTH OF JULY, 1912.

	Parcels.
Ships	28
Passed	38,246
Fumigated	1,805
Destroyed	66
Returned	2
Contraband destroyed	81½
Total parcels of horticultural products for month	40,200½

FINDINGS IN INSECT TRAPS.

During the month of July of the insects collected from the traps in the several localities, no specimens of any species of *Trypetidæ* were found in any instance.

PESTS INTERCEPTED.

From Hawaaian Islands—
- Live larvæ of *Dacus cucurbitæ* in cucumbers and melon.
- Live larvæ of *Ceratitis capitata* in mangoes.
- *Ceroplastes ceriferus* and *C. rubens* on Leis.
- *Pseudococcus* sps. and *Diaspis bromelia* on pineapples.
- *Lepidosaphes laisanthi* on crotons.
- *Parlatoria pergandii* on crotons.
- *Cryptorhynchus batatæ* on sweet potatoes.
- *Aphis* sps. and *Coccus longulus* on betel leaves.

From Japan—
- *Aleyrodes citri* on gardenia.
- *Aspidiotus lantaniæ*, *Hemichionaspis aspidistra* and *Parlatoria pergandii* on palm.
- *Parlatoria thea* var. *viridis* on maple.
- *Aspidiotus duplex*, *P. pergandii* var. *camellia* on camellia.
- *Coccus longulus* on Cycas.
- *Aspidiotus* sps. on *Thuya obtusa*.

From Manila—
- *Fiorinia* sps. on orchids.
- *Psyllid* sps. on arborvitæ.

From Mexico—
- *Chrysomphalus aonidium* on mangoes.

From England—
- *Cerataphis lantaniæ* on orchids.

LOS ANGELES DIVISION.

Horticultural imports.	Parcels.
From all foreign ports — 7 ships	
Passed as free from pests	5,367
Fumigated	----
Destroyed	----
Returned	----
Contraband in ship stores or passengers' baggage	1
Total	5,368
From North Pacific ports — 17 ships	
Passed as free from pests	1,060
Fumigated	----
Destroyed	----
Returned	----
Total	1,060
By railroads from United States and foreign points	----
Passed as free from pests	525
Fumigated	97
Destroyed	----
Returned	----
Contraband destroyed	15
Total	637

TOTAL FOR MONTH OF JULY, 1912.

	Parcels.
Ships	24
Passed as free from pests	6,952
Fumigated	97
Destroyed	----
Returned	----
Contraband destroyed	16
Total parcels of horticultural products for month	7,065

PESTS INTERCEPTED.

From Eastern States—
Pseudococcus citri on begonia.
Aphididæ sps. on chrysanthemum.
Aphididæ sps., *Chrysomphalus aurantii*, *Aspidiotus hederæ* on Kentia palms.
From Mexico—
Coccus hesperidum on aceitunas.
Lepidosaphes gloverii on lime.
Diaspinæ sps. on avocado.

SAN DIEGO DIVISION.

Horticultural Imports.	Parcels.
From Mexico	53 ships
Passed as free from pests	2,303
Fumigated	16
Destroyed	17
Returned	----
Contraband in ship stores or passengers' baggage	13
Total	2,349
From other foreign points	2 ships
Passed as free from pests	----
Fumigated	13
Destroyed	----
Returned	13
Contraband	----
Total	26
By railroads from United States points—	
Passed as free from pests	409
Fumigated	----
Destroyed	----
Returned	----
Total	409
By parcels post from Mexico—	
Passed as free from pests	1
Fumigated	----
Destroyed	----
Returned	----
Total	1

TOTAL FOR MONTH OF JULY, 1912.

Ships	55
Passed as free from pests	2,713
Fumigated	29
Destroyed (contraband or otherwise)	17
Returned	13
Total parcels for month	2,772

PESTS INTERCEPTED.

From Mexico—
Thrips sp. on potted plant (undetermined sp.).
Bean weevil (*Bruchus limbatus*) in "Guamuchile" bean.
Tamarind weevil (*Calandradæ* sp.) in tamarinds.
Parlatotia pergandii on unknown plant.
From Japan—
Gypsy moth larva (*Prothetria dispar*) on maple.
Pseudococcus pini on pines.
Aspidiotus sp.

EUREKA STATION.

	Parcels.
From Hawaiian Islands direct	2 ships

No horticultural products.

SANTA BARBARA STATION.

From Honolulu direct	1 ship

No horticultural products.

FRUIT FLY CONTROL.

SEVENTH REPORT.

HONOLULU, HAWAII, June 1, 1912.

To the Commissioners, Board of Agriculture and Forestry, Honolulu.

GENTLEMEN: I beg to submit the following report for the month ending May 31, 1912, viz.:

It is quite fortunate that the quarantined area in Honolulu and suburbs has been kept fairly clear of all ripe and overripe fruit other than the mango, of which latter there is an unprecedented crop. Our small staff of inspectors has been kept busy in an almost futile endeavor to keep all grounds clear of this fruit, the tree of which is now in full bearing. It takes but a glance at the number and fruiting conditions of these scattered trees to realize the stupendous work of efficiently gathering and destroying a fruit which during the season is continuously falling from all these large trees day and night. It is almost unnecessary to say that with such immense crops of mangoes extending over a period of three months or more perfect work in gathering and destroying these can not be expected, more particularly under the peculiar local conditions which exist in the area of approximately 50,000 acres under quarantine between Kaimuki and Moanalua. To properly cope with such conditions, it would take a force three times as large, and even then the work would be partially ineffective unless a very much larger proportion of householders coöperated. Of course, there are many who keep their grounds fairly free of fallen mangoes, but the large majority of residents and particularly those who can ill afford to employ a yard boy, leave the gathering of this fruit to our inspectors and such laborers as we are now forced to employ at odd times to help out the situation. Even where mangoes are not used by householders, there are but few, including the wealthier class, who voluntarily strip the trees or care to have this done for them. Again, there are a large number of vacant lots containing mango trees, the owners or controllers

of which it is difficult to locate. In the majority of such instances as these we will be obliged to strip and gather the fruit ourselves, as well as cart the same to the incinerator, if there is not sufficient brush to burn same on the premises. During the month we have had a wagon busy hauling several loads of such fruit every day and during June, if the pay roll will stand it, several more carts and day laborers will have to be employed. It is surprising what immense quantities of this fruit have been burned on the ground or else carted away to the incinerator since the season opened, all of which would have been left as formerly to ferment and rot on the premises, causing not only a very insanitary condition in localities, but also have been the means of an altogether unnecessary reproduction of fruit flies in countless numbers. Unfortunately there is a very bad fungous condition existing in much of the mango fruit which is causing it to rot and ferment before falling. This fermentation attracts numerous species of vinegar flies, the small maggots of which give the impression that the fruit is all infected with the Mediterranean fruit fly. Such is not the case, but nevertheless many of the fruits are really attacked by the latter pest and it is not possible to discriminate amongst such large quantities as daily fall to the ground. Whilst there is much good fruit on many of the trees and on the ground, it is best to be on the safe side and sweep up and destroy every one that has fallen. I am dwelling at some length on these peculiar conditions, as they are liable to happen to a more or less extent every summer during the mango season and they go far to prove what I have tried to impress upon the authorities and others from the start that it is useless to expect either a perfect control of the Mediterranean fruit fly in Honolulu and suburbs with a comparatively small appropriation and without that unity and coöperation of all residents which is so necessary in all artificial methods of control when these are performed in non-commercial areas. Without such unity and without such coöperation, even an appropriation of many more thousands of dollars will not be as effective as it should be. With conscientious and efficient work, however, clean culture and allied artificial methods, together with the proper coöperation of householders, will produce results in proportion to the amount expended. To a great extent this has already been manifest to proficient and unprejudiced investigators. Such mechanical work when performed by all in a proper spirit of coöperation can do no more than partially control this pest. In a tropical country like ours the so-called eradication or extermination of such a pest as Mediterranean fruit fly by mortal man is not possible. That it has been in a measure controlled or lessened in numbers by climatic conditions and artificial methods in other parts of the world is fairly well accepted, but such countries as have recorded these facts practically all have their fruits growing in orchards on a commercial scale, and again some of them have a mild winter frost, which occasionally checks the pest. Few places have a similar environment and tropical jungle of fruits all the year round as we have at our back doors. To a more or less extent very good results should obtain here, provided the same unity and

coöperation existed among all our residents as occurs in other places where large commercial interests are at stake. The point was raised by me early in the campaign as to the desirability of expending such a comparatively small appropriation as that which we are working with, and then expecting great results in view of local economic conditions, not only on this island, but also on others in the group. We have few fruits of commercial importance other than the bananas and pineapples, and these latter, under natural conditions, are so far not attacked by the fruit fly. When it is considered that artificial methods of control, such as clean culture, spraying, etc., means a continuity of immense appropriations, are not some people expecting too great results all at once from a comparatively small fund? Even the $35,000 which it appears congress will eventually appropriate to assist in this campaign will be but a drop in the bucket considering the scattered jungles of fruit trees in Honolulu and vicinity and the wild and mountainous expanses of territory here and on all the islands. These large areas not only have the guava and mountain apple on the slopes and in the valleys, but also fleshy seeds of indigenous trees, most of which latter are just as susceptible or adaptable to the pest as is the Kamani and coffee berry of the lower lands, two of the most infected fruits growing in the territory. However, as before stated, results as to artificial methods of control in any one region will be in proportion to the amount continuously appropriated for the work, provided that the latter is conducted under the well accepted methods of other countries and that unity and coöperation is at all possible.

The only hope I have, as has been repeatedly stated in previous reports, is in the discovery of a specific parasite. To find, introduce and successfully establish such a parasite would be worth the best part of any one large appropriation which either this territory or congress would set aside for clean culture methods. With the successful establishment of such a beneficial insect, nature's methods would accomplish much more in a general way of perfect control than we can ever expect by the usual artificial methods, more particularly if both of these were combined in a systematic and scientific manner. To this end every effort should be made to push the entomological research work in suitable tropical countries where this particular species of fruit fly is known to have its habitat in exceedingly small numbers. Such work, to be successful from a scientific and economic standpoint, should only be undertaken by entomologists of the highest order and who have had previous experience in successful work of a similar nature. In Dr. Silvestri, who is already preparing for the field, we have one of these men and the very best authorities indicate tropical West Africa (where he is going) as the most suitable place to explore for a parasite of the Mediterranean fruit fly. If later on funds are available, I believe it would be money well spent to assist this research work by the addition of another equally good economic entomologist and have him sent to another section of Africa where the fruit fly is not known to be a pest, but exists only in small numbers. It is quite possible that in such a

locality the fly is being controlled by either a parasitic or predaceous enemy, either of which might be found to some extent suitable to our requirements. Of course, such parasitic research work (particularly that of the Mediterranean fruit fly) is altogether problematical as to results, but the territory has already succeeded on similar lines under private organization and there is no reason why, under government auspices and with sufficient funds, a proportionate amount of success should not be obtained. In any case it would be settled once and for all whether future search for such a parasite was to be negative in results. The success of such work to a very great extent depends on the selection of the entomologists, not only for the field work, but also as to those who handle the material after it arrives safely at its destination. For obvious reasons only the most experienced of men in this class of special work should be allowed to handle such material.

Since my last report I have received a communication from the Chief of the Bureau of Entomology at Washington, D. C., in which he informs me that the congressional appropriation to assist the territory in the fruit fly campaign has passed both houses, and would eventually find its way to the President for signature. If signed, the appropriation will become available on July 1st, and will, of course, be expended under the direction of the Federal Bureau. The Chief Entomologist, Dr. L. O. Howard, in asking for coöperation and advice, states that he has engaged a Dr. Back to direct the expenditure, and that the gentleman would in all probability be in Honolulu early in July. After the arrival of Dr. Back, the Board will coöperate with the Federal Department in extending the work, which will no doubt be possible with the larger sum available. It goes without saying that Dr. Back will also have to undertake work of control on the other islands, which our small local appropriation has not made possible. As you already know, the insular inspection and control has been in the hands of district committees appointed by the island commercial organizations. The Board, however, has kept in communication with the chairman of these committees, has issued commissions to such inspectors as the latter have appointed and it has furthermore arranged with the territorial administration to apportion to the two larger islands a small sum to assist the various districts in the exclusion of the pest. Unfortunately, the fruit fly has since been discovered in almost every district on both islands, and it will not be long before the infestation will be general, owing to the uninterrupted large areas of guava and wild fruits which prevail along the upper slopes.

In view of changed conditions as to prevalence of fruit fly on the other islands, there may perhaps be necessity for a slight modification in the territorial regulations as now in force. I do not think, however, that any change should be made until we have received an expression of opinion from the district and commercial organizations on each island.

The alleged complaints because of a failure to export fruits and vegetables from any of the other islands to Oahu were based on a wrong interpretation of existing regulations by officials over whom this Board

had no control. There have never been any legal restrictions as to the importation of such supplies on Oahu since the fruit fly was first discovered here. The misunderstanding was easily and satisfactorily settled as soon as investigated.

In addition to the usual inspection, gathering, and destruction of fruit, which has been maintained during the month, there has also been considerable spraying of large sections of fruit gardens in and about Honolulu. Experimental trapping for adult fruit flies under the Australian method (kerosene and other solutions) has also continued. Much more of this latter work, as well as spraying, will no doubt be possible as soon as the congressional appropriation is available after Dr. Back's arrival. The spraying solution used is the well known Cape Colony (Mally) formula, viz., proportions of arsenate of lead, molasses and water. Our small appropriation, which had to last for over a year, or until the next legislature convened, has not made it possible to spray beyond the experimental stage, although during May much has been done by a special gang on these lines. I have refrained from this method in the neighborhood of large colonies of honey bees, as it is quite possible that the solution may poison the workers in more or less numbers. As the honey business in the territory has increased to large proportions of late years, and is, in fact, equal, if not greater, than any commercial interests in fruits other than pines, I am inclined to disfavor spraying with poisoned solutions in sections where hives are kept on a commercial scale. When Dr. Back arrives I shall present this feature to him most forcibly, and, if possible, prevail upon him to restrict spraying, as I am doing now, to such areas as are not frequented by large numbers of bees seeking food.

I have also to report that as a result of laboratory work the fruit fly has been bred naturally out of—

Fleshy seeds of the sugar palm (*Arenga saccharifera*), and the fruits of the Elengi tree (*Mimusops elengi*).

The above list may be added to the already extensive breeding results from our laboratory.

As there is a possibility that the labor gangs of the Sanitary "Clean-Up Day" Committee may mix quantities of fruit with other garbage on June 20th (clean-up day), I shall communicate with the above organization and request its coöperation in order that the fruit gathered may be sent immediately to the incinerator and not left indefinitely on side walks or dumps. I intend further to show that the Board has a desire to coöperate in the general clean up of the day by loaning them our full staff of inspectors.

Mr. Weinland, the representative of the California Horticultural Commission, has, during May, increased his staff of inspectors of fruits, etc., intended for shipment to the coast. This has proportionately reduced our own gang for the time being. I shall immediately bring up our own staff to such proportions as the monthly apportionment of both the California and territorial appropriations will permit.

During May I made a short visit of inspection at Hilo, Kau and Kona. In the latter district I stayed the best part of a week investigating fruit fly conditions in coffee. As the pest distributed itself throughout the district in a very short time after its first discovery, the planters were somewhat alarmed as to what might be the result to their coffee and other crops. I found the district well organized as to a "Control Committee" and the members of the district club appeared alive to the fact that they would have to take preventive means to stop an overproduction of the fly. Owing to the nature of the ground, which is mostly disintegrated "lava," it is hardly possible to do any systematic clean culture work, but there is no reason why the spraying and trapping method should not be carried out with some success if properly attended to. Kona's coffee is grown in fairly large and uninterrupted areas, and therefore the spray could be done by each small planter and by others interested on a commercial scale and with less difficulty than in other sections on the islands. Furthermore, the berries are in most instances pulped at central mills, and the pulp pile can be treated with lime or acid and an enormous percentage of maggots destroyed. It has not been demonstrated to what extent the coffee berry or the bean is damaged by the maggot. Apparently it does no particular harm, but it would be rash to finally conclude that such is the case. The question involves a series of experiments by both chemist and plant pathologist. During this visit I was accompanied by Mr. D. Fullaway of the U. S. Experiment Station, and both of us had several conferences with the Kona Control Committee, looking to the further organization of artificial methods of control to suit conditions in that district.

I am indebted to Dr. Wilcox and Mr. Fullaway, both of the U. S. Experiment Station, for official courtesies and coöperation rendered in the control work during the past month. The office also extends its thanks to Mr. G. Wilder for samples of infested fruits used for laboratory purposes.

W. M. Giffard,
Director, Fruit Fly Control, T. H.

INSECTARY DIVISION.

REPORT FOR THE MONTHS OF JUNE AND JULY, 1912.

By E. K. Carnes.

The following gives the total distribution of beneficial insects of all species, in response to 872 applications:

	June.	July.	
Hippodamnia convergens	265,000	1,211,000	
Comys fusca	27,500	-------	
Novius (Vedalia) *cardinalis*	775	560	
Coccophagus lecani	4,000	-------	
Caliephialtes messor	180	90	
Chilomenus sexmaculata	1,875	2,075	
Pteromalus puparium	------	75	
Cryptolæmus montrouzieri	------	300	
Encyrtus flavus	------	75	
Rhizobius ventralis	25	425	
Aphelinus fuscipennis	------	2,100	
Chilocorus bivulnerus	475	380	
Aphycus lounsburyi	------	25	
Aspidiotophagus citrinus	300	-------	
Totals	300,130	1,217,105	1,517,235

Up to the present date we have received sixteen packages by parcels post from South Africa, containing branches infested with black scale (*Saissetia oleæ*), and carrying the parasite *Aphycus lounsburyi,* which preys upon the half-grown scale. Your superintendent is happy to report that we have a breeding case well stocked with adults of this species, from which we expect to establish this valuable adjunct to *Scutellista cyanea* and *Rhizobius ventralis* in controlling the black scale.

The coccinellid *Chilomenus sexmaculata* from India, a start of which was kindly given us by Professor Timberlake of the U. S. Department of Agriculture, is doing nicely. We have liberated close to 3,000 individuals of this species from the original start of 30 adults.

The following table and accompanying notes cover our observation and show the progress that is being made with *Chilomenus sexmaculata:*

Eggs laid—

Lowest number	602	in 50 days
Highest number	1,114	still laying.
Average number	803	

Life history—

Egg stage	3 days	Larva eats from 80 to 140 aphids during its life: average number eaten by 9 larvæ—106.
Larval stage	10 days	
Pupal stage	3 days	
Total	16 days	

Adult eats about 30 aphids per day.

Liberated 1,975 larvæ in Capitol Park on oleanders and elms.
Liberated 275 larvæ at Palo Alto on squashes and beans.
Liberated 600 larvæ in breeding cage at Insectary (fed on oleander aphis).

2,850 total number of larvæ liberated.

Liberated 100 adults in Capitol Park from breeding cage.

Find pupæ and adults in park now, and species seems to be becoming established on oleanders.

Found several adults at Palo Alto two weeks after liberating larvæ.

In order to permanently settle the very important question of the life history, reproductive power and feeding habits of the coccinellid, *Hippodamia convergens*, which the Insectary distributes in such immense quantities, a very elaborate set of experiments was instituted and we herewith present the result of this work to our growers, in connection with our report, as we consider it of vast importance in setting at rest many doubtful points with reference to this extremely valuable species, thereby clarifying and elucidating many obscure features in connection with our work along the line of conservation of our native beneficial insects. The Insectary is glad to be able to work out these various life histories.

The Insectary is glad that we are now in a position to be able to devote time to working out the complex problems of the life histories of our various species, and while the article is of some length, we urge upon our readers the importance of becoming familiar with this species, which is of the greatest general benefit to all classes of our growers. When we consider the tedious labor, the close observation, the volume of detail work connected with the experiment, we feel, that in asking the closest attention of our growers to the subject, we are not transgressing their liberty, but instead, it is an earnest effort to be of real assistance to them.

The detail work in connection with this experiment has been under the personal attention of Mr. E. J. Newcomer, assistant at the State Insectary.

SOME EXPERIMENTS WITH THE COMMON LADYBIRD (HIPPODAMIA CONVERGENS).

For several seasons the Insectary has sent out to the growers of the State large quantities of ladybirds (*Hippodamia convergens*), which feed on various species of aphids. It has been demonstrated beyond a doubt that these little red beetles are of great benefit in destroying the aphids. Every one, who has watched them to any extent, knows that they possess voracious appetites, and that they multiply rapidly. The larvæ are even more voracious than the adults, spending practically their whole existence hunting and devouring aphids. A number of questions regarding these ladybirds have arisen at various times, which heretofore have not been satisfactorily answered. How many aphids does a single larva or a single beetle eat in a day? How long does a ladybird live after coming out of cold storage? How many eggs does a single female lay, and how soon does she begin to lay them? And how long does it take an egg to hatch and the larva to develop into an adult?

In order to definitely answer these questions, we undertook, about the middle of May, an extensive series of experiments, which were completed late in July. We confined the beetles in large vials stoppered

with cotton. In some of the vials we put a single beetle, in others, a pair, that is, a male and a female. Each morning the vials were gone over and a number of aphids, which were carefully counted and recorded, put in each, together with a leaf of their food-plant. The following morning the aphids remaining were counted and the number eaten by the beetles recorded. When the beetles began ovipositing, the eggs had to be removed and counted each day; or if the eggs were fixed to the glass, the beetles were transferred to a fresh vial. We soon discovered that the beetles sometimes preferred to eat their own eggs rather than the aphids provided. As most of the eggs were laid during the afternoon, we removed them late in the day, thus saving them. The eggs were kept until they hatched, and the larvæ not wanted for further experimenting liberated on aphid-infested plants. Absolutely nothing except aphids was given the beetles throughout the experiment.

Life History.

Returning now to the questions enumerated above, let us first follow the development of the insect, that is, its life history, from the time it comes from hibernation, or from cold storage, as is the case with the ladybirds which we distribute to growers, through the egg, larval, and pupal life to the adult again. The adults used in these experiments undoubtedly went into hibernation in the Sierra foothills some time in the fall of 1911. They were collected, along with thousands of others, in February of this year, sent to the Insectary, cleaned and packed, and placed in cold storage. Some of the boxes were taken from cold storage May 13th, and the specimens experimented with were among these.

When the ladybirds are removed from cold storage they immediately begin to mate, but no eggs are laid until they are supplied with food. With a plentiful supply of food, the female begins laying eggs in from thirteen to seventeen days after mating. Thereafter, the egg-laying continues daily, with an occasional exception, until the insect dies. The eggs are yellow and spindle-shaped, and are deposited on end on the leaves in clusters. Usually all the eggs laid during any one day are placed in one or two clusters, but if the female is disturbed, there may be more. The eggs are mostly laid during the afternoon, the night and morning being spent in feeding.

The length of the egg stage varies from three to six days or more, depending on the temperature. When the temperature stays below 70° F., the eggs will take six days or more to hatch, while if the temperature rises above 90° F., they will hatch in three or four days. The eggs, which are at first a bright orange yellow soon become a lighter and duller yellow, and finally, as the time approaches for the larvæ to hatch, dull gray. Soon after this, the shell of the egg splits across the top, and the tiny larva works its way partly out. At first it is light gray in color, with a yellow head and legs. It pulls the legs out of the shell and remains with the hind part of its body in the egg until its legs have become straightened, and the body hardened. As this takes place, the

body color darkens, and the head and legs become black. Then the larva is ready to take care of itself, and it scrambles out of the old egg shell and goes in search of its prey.

It is really amusing to watch a young ladybird larva attack an aphid which is often twice as large as its own self. When an aphid is feeding, its beak is thrust into the leaf or stem of the plant, and it can not readily remove it in order to escape from an enemy. The awkward little larva, in its wanderings, comes across such an aphid, and loses no time in getting a meal. It holds the victim with its fore legs, and thrusts its tiny mandibles or jaws into the aphid's body, eagerly sucking out its life juices. The aphid does not die at once, but slowly pulls its beak from the plant, and if it is large enough, walks away, dragging its enemy behind it. The young larva is not at all discouraged by this, but clings to the aphid with the tenacity of a bulldog, and the victim is soon so weakened from loss of blood that it can no longer move, whereupon the larva finishes it off, and goes in search of another. When aphids are scarce, we have often seen as many as a half dozen small larvæ clustered about a single one, each sucking out a share of the food. And if there are no aphids at all, the larvæ do not hesitate to attack each other. It is a universal rule among predaceous animals that when no food is to be found the weaker are devoured by the stronger. In the case of the ladybird, the adults are so protected by their horny covering that they can not eat each other, but the eggs and larvæ are frequently eaten.

The larva grows very rapidly, and its skin soon becomes too small for it. The skin is shed, and another, looser one has already formed beneath, which allows the larva to grow some more. In all, there are four molts besides the final one when the larva changes to a pupa. The stages between molts last from two to four days, depending on temperature and food supply. The final larval stage usually lasts for about six days, at the end of which time the large black and orange larva hangs itself up by the tail in some sheltered place and remains quiet for a day or two. Then the skin is shed, and the black-spotted, yellow pupa is seen. The larval stage occupies about eighteen or twenty days. In the pupal stage the insect is unable to take any food, but remains fixed, only wriggling slightly when disturbed. Within, wonderful changes are taking place: wings and new legs are developing; a new set of mouthparts is forming; and every organ in the body is undergoing a transformation. In the incredibly short time of six or eight days the old larval tissue has been changed into a complete adult ladybird.

The adult escapes from the pupal skin through a split along the back. At first it is very soft, and the crumpled wing covers are light yellow in color and without the characteristic spots. In the course of an hour or two they straighten out and the black spots appear, but the color does not become red for several days, and in some individuals it remains yellow during their whole life. These adults begin laying eggs in a week or ten days. The complete life cycle thus occupies, approximately, thirty days.

Egg-Laying Records.

A single adult female lays a large number of eggs, and the egg-laying period extends over a month or six weeks. We had one remarkable female that lived for over two months from the time it was taken from cold storage, that is, from May 13th until July 24th. It began laying eggs on May 27th, and stopped July 16th, there being only three days during that period when no eggs were laid. In all, the astonishing number of 1,550 eggs were deposited, being an average of thirty eggs a day during the egg-laying period. On six different days fifty or more eggs were laid, and on one of those there were deposited sixty-one eggs. We are convinced that this particular specimen was abnormally prolific, as it far outreached any others in the number of eggs deposited. It also consumed more aphids in a day than any of the other cold-storage beetles, though some of those from the second brood surpassed it, as will appear later.

The other beetles which we kept, except one that died prematurely after depositing a hundred eggs, were quite uniform in the number of eggs laid per day, though there was a considerable difference in the total number. The lowest number laid was 421, with a daily average of fourteen, and the highest was 666, with a daily average of sixteen. The average total number laid by these was 532, and the average number laid in a day was fifteen. These beetles were from cold storage, as well as from the second brood.

Feeding Records.

SINGLE BEETLES.				PAIRS.				
Number.	Days fed.	Number of aphids eaten.	Average number eaten per day.	Number.	Days fed.	Number of aphids eaten.	Average number eaten per day by both.	Average number eaten per day by each.
1	6	89	14.8	12	52	2,727	52.4	26.2
2	28	1,191	42.5	13	14	679	48.5	24.2
3	19	244	12.8	14	56	4,411	78.7	39.3
4	11	270	24.5	15	5	146	29.2	14.6
5	12	194	16.1	16	5	152	30.4	15.2
6	6	76	12.6	17	26	1,176	45.2	22.6
7	9	223	24.7	19	14	452	32.3	16.1
8	40	1,736	43.4					
9	16	206	12.8	Totals			45.2	22.6
10	12	269	22.4					
11	8	113	14.1					
18	11	185	16.8					
20	9	141	15.6					
Total			21					

Average number eaten per day by all beetles, 21.8.

A considerable variance in the average daily number of aphids consumed will be noticed in the above table. Nos. 2 and 8 are far above the others. These were individuals of the second brood, which seems to indicate that the cold-storage insects eat less than those appearing later.

Among the pairs, No. 14 is higher than the others. It was the female of this pair that laid the very large number of eggs referred to above.

There are several factors which directly affect the number of aphids eaten by these ladybirds. The temperature has a very decided effect on their appetite. In cool weather they averaged from twelve to fourteen aphids per day, but during hot spells as many as fifty or sixty were devoured. The highest number recorded was 67 by No. 2. It is natural, also, that the egg-laying individuals should demand more food than the others, and this proved true. The table given above shows that the pairs averaged more aphids each per day than did the single beetles, and this was due to the greater appetite of the egg-laying females. It was noted, too, that larger quantities of aphids were eaten on days when the largest number of eggs were laid than on others.

The ladybirds show a preference for certain species of aphids. In the course of our experiments we fed them with a number of species, chief among them being the citrus aphis (*Aphis gossypii*), the plum aphis (*Hyalopterus arundinis*), the rosy apple aphis (*Aphis sorbi*), the rose aphis (*Macrosiphum rosæ*), the oleander aphis (*Aphis nerii*), and an undetermined species on the strawberry bush. Our experiments in this direction were not extensive enough to warrant any figures being given, but, in general, we noticed that the species on the strawberry bush and the plum aphis were the favorites while the oleander aphis was eaten only in small numbers. We know too, from observation, that the bean aphis (*Aphis rumicis*), melon aphis (*Aphis gossypii*), and hop aphis (*Phorodon humuli*), are eaten in large numbers.

No definite daily average can be given for the number of aphids consumed by the larvæ. An adult beetle when it emerges from its pupa is full grown, and remains the same size throughout its life. All the food it takes goes to build up tissue worn out by exercise, just as in any other adult animal, and to provide material for the making of eggs. It is different with the larvæ. A larva is a constantly and rapidly growing creature, getting larger every day, and thus needing more food every day. Then, at the molting times, the larva takes no food for several hours, or perhaps half a day, and the total amount of food eaten on that day will be less than on others.

Our records show us that a single larva will consume during its life in the neighborhood of 250 or 300 aphids. It is satisfied on the first day of its life with one or two small aphids, while when nearly full-grown it demands sixty or seventy. We have seen above that the larval life occupies some eighteen or twenty days. Thus, the general average is about fifteen or sixteen aphids a day.

Conclusions.

We have attempted, by means of these experiments, to give the grower a definite idea of the value of these ladybirds. He may feel morally certain that they are of decided benefit, but is unable to give proofs. These figures will go a long way towards affording proofs of their value. It must be remembered, however, that all these experi-

ments were conducted under abnormal conditions, and that the figures given will not necessarily apply in all cases.

In the first place, the temperature in the breeding vials undoubtedly averaged higher than that out of doors. But this can be neglected, as the temperature varies a great deal in the various parts of the State where ladybirds are sent. The amount of exercise which the insects get under confinement might be questioned. Our insects were continually crawling and even flying about in the narrow space given them, and it would seem that their activity was not greatly lessened. Our ladybirds always had a plentiful supply of aphids, which might not be the case with ladybirds in the field. But ladybirds liberated in heavily infested orchards and fields would have no difficulty in finding enough to eat. The greatest difference in the conditions obtaining with our insects and with those in the field is the matter of protection. Ladybirds in the field, and particularly the larvæ, are constantly assailed by a variety of predaceous enemies, such as soldier-bugs, the larvæ of the lace-winged fly (*Chrysopa*), and others. The larvæ may be washed or blown from the plants, and probably would be unable to get back. In our breeding vials, of course, the insects are afforded protection from all these foes. A little figuring will show how rapidly they could multiply under these conditions. Suppose a single female deposits 500 eggs: It takes these eggs thirty days to become mature beetles, half of which are females. In the five months from May 1st to October 1st the progeny of a single female beetle will be something like 976,562,500,000 insects. This is only theoretical. In reality, the ultimate progeny of any one pair of ladybirds is one pair of ladybirds. For there are about the same number of individuals of this species one year as there are the next. Of course, the number will fluctuate more or less, according to the available food supply, but, in general, the total remains the same. These figures do show, however, that the ladybirds can and do multiply very rapidly under favorable conditions, and it is undoubtedly true that there are many more individuals in existence during the time when aphids are plentiful than at the beginning of the season.

Field Observations.

About the middle of July the Superintendent and Field Agent made a trip to the mountains to make observations in connection with the summer habits of *Hippodamia convergens*, and collected and shipped to the Insectary 250 pounds of adult beetles. Observation and comparison of the habits of this species, both in the open and under confinement, have been made and will continue throughout the year; this we hope to continue into the actual commercial fields, and will finally present a complete résumé of the life history and habits of this little understood, but extremely valuable native adjunct to the successful production of paying crops in this State.

Identification Work.

To assist and encourage our county horticultural officers and growers in their work, and to make available another useful feature of the State Insectary to the growers in general, we have inaugurated a new system of identification, mounting, pinning, disbursement of general horticultural information, and direct aid, which is meeting with hearty coöperation.

We are trying to *take the Insectary to the people*, instead of having the people come to the Insectary, and to encourage the use of this department by every citizen in the State. With this end in view, we have agreed to receive all specimens of whatever nature sent us, if in the insect line, prepare and pin them, properly classify, label and return, which serves to illustrate the proper manner in which to prepare the different orders, and which will act as a guide for the various county officers and growers, in preserving their own collections for future use, so that they can identify by comparison. In order to facilitate matters, and create interest, we prepare and send to all interested a collecting bottle and mailing case, and thus enable them to immediately avail themselves of the offered assistance. The manner in which they have responded is sufficient evidence that our efforts have been appreciated.

The accompanying stock letters, with a few replies to same, will give you a better idea of our method of procedure.

During June the Insectary made an exhibition of destructive and beneficial insects and injurious plant diseases, showing something over seventy-five different subjects, which were mounted in our glass front exhibition plaques, and which brought forth many expressions of commendation.

In addition to making the exhibition for economic purposes, our idea was to show the process of making the plaque and preparing the exhibit, in order that our county commissioners might embrace this feature in preparing their respective county collections, and which would be of much benefit.

(Copy.)

August 9, 1912.

Dear Sir: The State Insectary has been assisting you by sending colonies of beneficial insects to prey upon those forms that are detrimental to horticultural and agricultural pursuits.

This department wishes to be of further assistance to you, if possible.

Is there not some insect or tree disease, with which you are not familiar — some condition existing in your field or orchard upon which you would like information? Of all the numerous insects or peculiar spots, etc., on vegetation that you notice, are you able to say what they are, and if the insects are good or bad?

California growers are now living in a highly specialized period, and exact knowledge is an essential necessity in connection with successful production. The seemingly most unimportant discoloration or inconspicuous insect may be the start of a very serious pest or destructive disease.

The State Insectary is a grower's institution, and we wish you to make use of this department by submitting specimens. Also write us freely regarding existing conditions, as regards the health of your trees or crops. This department wishes to aid you by giving or procuring for you exact information, and we urge upon you to embrace this opportunity, which may be the means of saving you considerable time and money later on. If we are unable to answer all your questions, we will divert

them to some other department of the State Commission of Horticulture, which specialize along specific lines.

All our beneficial insects are sent free, postage or express paid. All information is free and gladly furnished. This is your institution — you own part of it; make use of it. The policy of the present administration is to make every state institution of direct benefit to the people.

Become a regular correspondent of the Insectary; send in anything with which you are not familiar, and by so doing allow us to assist you to produce larger crops of cleaner fruit for less cost. Yours for the grower.

Very truly yours,

CALIFORNIA STATE INSECTARY,
E. K. CARNES, Supt.

COPY OF LETTER SENT TO COUNTY HORTICULTURAL COMMISSIONERS.

July 29, 1912.

DEAR SIR: We are sending you, under separate cover, a mailing box with cork bottom, for pinned and unpinned specimens.

Believing that you are interested in making a collection of the insects that occur in your section, or that you meet with many insects with which you are not acquainted, and would like to know more about, we are sending you this mailing box, and would ask that the State Insectary be allowed to assist you in your work.

The plan suggested is this: As you come across any insect, no matter how seemingly unimportant, put it in the mailing box and send it to us. The Insectary will mount it (or them) for you, classify the same, pin, label and return to you in the same package, and you can then transfer them to your cases, or even cigar boxes with linoleum covered bottoms, and you will be surprised to see how soon you will have a fairly good collection, from which to identify, by comparison.

The box can be kept busy going back and forth. Please send as many of each kind as possible, so that we may also retain a specimen, and in this manner the benefit will be mutual.

If we find that you take an active interest in this work, we will be glad to fix up additional mailing boxes for you, so that no delay will be caused waiting for the return package.

Inside the box you will find a "killing bottle" ready for use, in which you can drop your live specimens for a couple of minutes, after which time they may be removed dead, and are ready for mailing for identification. The "killing bottle" is presented to you with our compliments.

Acquire the habit of always carrying your "killing bottle" in your pocket, so that you will always be ready to pick up a specimen when you see it.

Assuring you of our every effort to be of real assistance to you in your work, we are,

Yours very truly,

(Signed) CALIFORNIA STATE INSECTARY,
E. K. CARNES, Supt.

EDITORIALS.

INSPECTION AT HONOLULU.

Some complaints have been heard concerning the inspection service being maintained at Honolulu by the present Commissioner of Horticulture. Those who were at the Santa Barbara Convention will remember that special attention was called to the fact that under the present governmental and territorial laws of Honolulu there was no authority whatever to enforce the inspection of any fruits leaving the territory. It was also strongly emphasized that the inspection of personal baggage was entirely beyond the power of any inspector there. Mr. H. A. Weinland was sent to Honolulu to aid in the clean-up campaign and to prevent as far as possible the selling of infested fruits in the Honolulu markets. He also made it a point to see that the steamship companies lived up to the agreement which allows the State quarantine inspectors at San Francisco to inspect personal baggage. Upon his arrival at Honolulu he found that at least two steamship companies were not issuing the agreements to have this done, and he immediately corrected their negligence. All who are familiar with the work in the Hawaiian Islands will agree that Mr. Weinland has done much to prevent the introduction of the fruit fly into California, by aiding in the clean culture work; by preventing the shipment of bananas from infested areas and seeing that proper wrappers were used; by enforcing inspection of bananas and preventing the importation of ripe and bruised fruits; and more important than all, seeing that the steamship companies enforced the contract allowing the inspection of personal baggage at San Francisco. While he has not the power to enforce a complete quarantine at Honolulu, he has done so much for the horticultural interests of this State that we wonder how any one appreciating our vast industries can criticise the things which he can not lawfully do.

The passage of the national quarantine law will put a different phase on the work in the Hawaiian Islands. While it is practically admitted by the government officials in charge that the clean culture work will continue in the islands, it is also claimed by them that under the national law all host fruits of the Mediterranean fruit fly will be refused to passengers and steamship companies at Honolulu. The enforcement of this regulation should practically stop the ship stores which are now so regularly seized by the quarantine inspectors at San Francisco.

We hope for much at the hands of the United States Government, and it is expected that complete charge of the work will be immediately taken over. Just what will be the eventual outcome is not yet known, but we have every reason to believe that the conditions will be so materially bettered as to make the danger of introducing the fruit fly of very small import.

THE PRESENT QUARANTINE FORCE.

Perhaps a great many of our readers have not noticed the steady increase of the work and force in the Quarantine Division of the State Commission of Horticulture. With the appointment of Mr. Maskew has come a greater development than was ever known in this work before. The reports of the division for the months of June and July will show these interesting facts: That the Quarantine Division is made up of five stations, as follows: San Francisco, Los Angeles, San Diego, Eureka and Santa Barbara. At San Francisco Chief Deputy Frederick Maskew has his office, with George Compere as Chief Quarantine Inspector, and B. B. Whitney, L. A. Whitney, Lee A. Strong and Archie C. Chatterley as quarantine inspectors. The southern division of the quarantine service is under the direct charge of A. S. Hoyt, with Quarantine Inspectors C. H. Vary at Los Angeles and E. O. Amundsen at San Diego. Mr. George B. Weatherby, Horticulture Commissioner of Humboldt County, as State Quarantine Guardian, has charge of the Eureka Station, while C. W. Beers, Horticultural Commissioner of Santa Barbara County, is the State Guardian at Santa Barbara.

It will be seen that during the past ten months one quarantine inspector has been added in the southern part of the State, three at San Francisco and a quarantine guardian at Eureka.

If one will take the trouble to canvass any other section of the United States or the world, he will find that no like territory is so strongly guarded as the California coast line. Certainly the growers of this State should not overlook the efforts of the present State Commissioner of Horticulture in his endeavors to protect the horticultural interests of this vast territory in such a thorough way.

In speaking of the work at San Francisco, C. L. Marlatt, of the Bureau of Entomology, said that it was the best in the world to-day.

DEMURRAGE ACCRUING ON SHIPMENTS OF TREES AND PLANTS HELD FOR INSPECTION OR TREATMENT.

It will be of interest to county commissioners and inspectors, as well as to nurserymen and growers, to know that demurrage accruing on shipments of trees and plants held for inspection or treatment may be legally waived, and that no extra charges will probably be made in the future. The above assertions are based upon the following correspondence in reply to the inquiries of Commissioner A. J. Cook covering this point:

SAN FRANCISCO, August 16, 1912.

Mr. A. J. Cook, State Commissioner of Horticulture, Sacramento, California:

DEAR SIR: With further reference to your letter of May 15th, which was by mistake placed in our files, regarding demurrage accruing on shipments of trees and plants which you find it necessary to inspect or fumigate and thereby causing demurrage to accrue:

The Commission is of the opinion that if these shipments are held subject to the orders of the horticultural authorities in compliance with the law or regulations of

the horticultural commission, beyond the free period, demurrage may legally be waived.

We are to-day writing the manager of the Pacific Car Demurrage Bureau, a copy of which letter is attached, which we trust will relieve the situation.

Yours truly,

RAILROAD COMMISSION OF THE STATE OF CALIFORNIA,
(Signed) H. H. SANBORN, Rate Expert.

SAN FRANCISCO, August 16, 1912.

E. E. Mote, Manager Pacific Car Demurrage Bureau, Wells Fargo Building, San Francisco, Cal.:

DEAR SIR: State Commissioner of Horticulture Mr. A. J. Cook calls attention to the fact that it is frequently necessary for representatives of his Commission to inspect trees or plants in accordance with the laws or regulations of his Commission, and in so doing cars are often held overtime, as it is impossible to complete the inspection within forty-eight hours' free time.

This is to advise you that the Commission is of the opinion that whenever cars are held for such inspection beyond the free period, demurrage may lawfully be waived, it being beyond the control of the consignee that the shipments are delayed in unloading. In handling demurrage charges arising from such circumstances will you kindly bear this letter in mind?

Yours very truly,

RAILROAD COMMISSION OF THE STATE OF CALIFORNIA,
(Signed) H. H. SANBORN, Rate Expert.

LECTURES ON HORTICULTURE.

The present State Commissioner of Horticulture, Dr. A. J. Cook, believes that it is the function of his office to keep in close touch with the various fruit and agricultural interests of this State. During his ten months in office he has made at least twenty-five public addresses. He has recently planned a tour throughout the San Joaquin Valley and southern part of the State, with his itinerary briefly as follows:

September 5th, Modesto.
September 6th, Atwater.
September 7th, Madera.
September 8th, Tulare County.
September 9th, Tulare County.
September 10th, Porterville and other places in Tulare County.
September 10th, Los Angeles.
September 12th, Redlands.
September 13th, Riverside.
September 14th, Pomona.
September 16th, San Diego.
September 17th, Orange or Fullerton.
September 18th, Santa Paula.

After this he also expects to make a similar tour of the northern part of the State, in order to ascertain at first hand the exact conditions there.

ARIZONA AND INSPECTION OF MEXICAN FRUITS.

It will be interesting to all California to know that Arizona has recently passed a law revising and giving added power to those in charge of the horticultural work there. With regard to the new work in Arizona, Dr. A. W. Morrill, State Entomologist, writes the following:

The Commission of Agriculture and Horticulture under our new law has informally adopted a quarantine restriction prohibiting the importation of mangoes, guavas and oranges from Mexico. This quarantine order will be formally adopted as soon as the members have qualified for their new appointments under the amended law, which I expect will be in the course of a few days. During the next few weeks I shall be busy organizing our inspection service, and I expect that before the end of September I will have completed arrangements for the protection at Nogales similar to that which you have in California at your Pacific ports. As soon as the quarantine order of the Commission has been formally agreed upon I will send you a copy. These orders will include a quarantine order against white flies affecting citrus, the alfalfa weevil, and the Mexican orange maggot.

CITRUS SCAB.

Cladosporium citri, Massee.

By H. S. Fawcett.

Introduction.

The following account of Citrus Scab and the fungus causing it was written as Bulletin No. 109 of the Florida Experiment Station, and is based entirely on investigations in Florida. Up to the present time the writer has not found any of this fungus in California. Lemons have been found in some cases with raised lumps, or with scab-like surfaces, which might lead one, at first sight, to suspect the same trouble, but the entire absence of any of the characteristic warts and pustules on leaves of sour oranges and lemons in California makes it seem almost certain that the same fungus does not occur here, or if present, does not produce the same effect as in Florida. Swingle and Webber said in 1896 (see

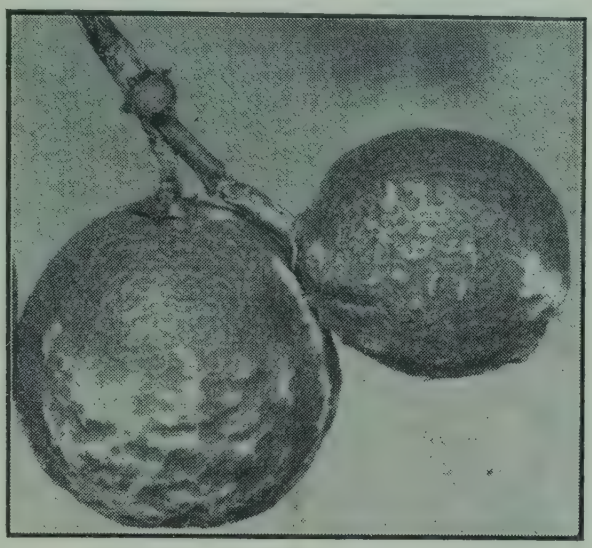

Fig. 253.—Scab on young oranges.

under History of Scab) "Although many thousands of trees afflicted with scab have been sent to California it seems that the disease is unable to exist there permanently." The illustrations, except Fig. 252, are also from the Florida Experiment Station Bulletin No. 109. Figure 252 was photographed from a dried specimen of a Satsuma orange in the museum of the California State Insectary. It was said to have been taken in quarantine at San Francisco in a shipment of fruit from Japan, during the year 1910.

The disease called Scab attacks the fruit and leaves, and sometimes the tender shoots. It is caused by the growth of a minute parasitic fungus which is somewhat similar to the fungus which we call yeast. The scab fungus arises from a spore or seed-like body about the shape of a grain of wheat, but less than one billionth as large in volume.

From the spores there grow out short tubes or hollow threads filled with living protoplasm, which penetrate the skin, and feed on and injure the growing tissue of the citrus tree. In consequence of the presence of these minute filaments, the tissues of the plant become swollen around the point of infection, breaking the skin and causing projecting warts or scabs (Figs. 253, 254 and 255). During the growth of these little scabs, the fungus filaments multiply in them, and send short branches outward from the surface on which are formed thousands of spores like

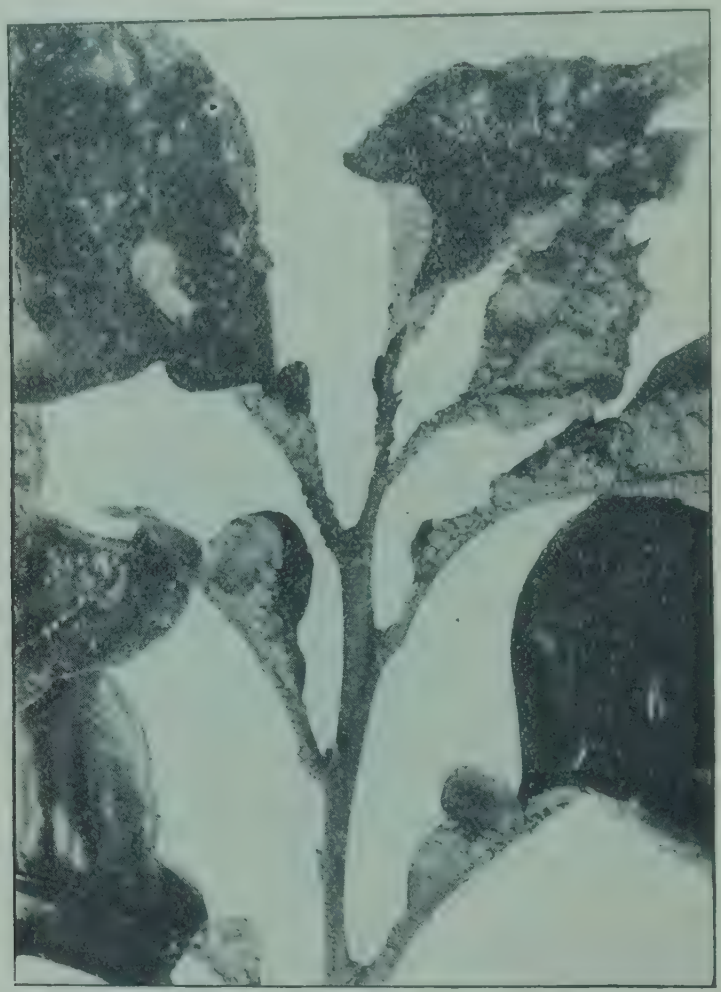

FIG. 254.—Scab on sour orange leaves.

the one from which the fungus originated. These spores may be blown or carried by insects to the vigorous young leaves and fruit of healthy trees and infect them in turn. All this goes on unseen by the unaided eye, and can only be detected by the aid of a compound microscope.

This fungus causes sour orange and lemon fruits (and sometimes Satsumas) to grow misshapen and unsightly. In severe attacks, corky projections of a dark gray to tan color extend from the surface. Between these warts the skin is usually of a normal color. These irregular corky projections often grow together into a large, raised

corky scab. In less severe attacks, especially when scab appears on grapefruit and on tangerines (or rarely on sweet oranges), in place of the warty irregular projections there are seen more or less raised flat patches of variable shape and size. The surface of the raised portion is finely scabbed or lightly scurfed. This milder form of the disease can usually be distinguished from "thrips marks," or other forms of scurf, by the patches being raised; but it can be distinguished with certainty only by the use of the compound microscope.

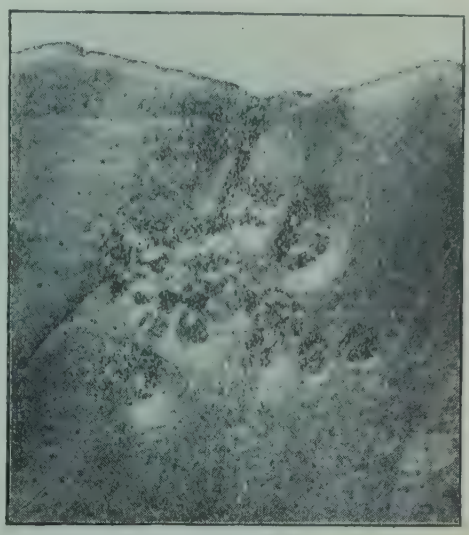

FIG. 255.—Early stage of pustules of Scab on sour orange leaf. Magnified three times.

The injury caused by the disease is nearly always confined to the visible areas of infection. There appears to be little indication of any poisoning effect on distant tissue. The earliest infections appear on either surface of leaves just unfolding, as minute light-brown points. These spots become depressed on one side, and raised on the other. Older spots become dark brown and sometimes pinkish. The spots grow together as they enlarge, forming the irregular, corky scabs. The leaves become twisted and warped. The disease is usually severe on lemons and sour oranges. Satsumas are often badly attacked, but only occasionally is grapefruit affected.

History of Scab.

Scab, or Verrucosis, appears to have been unknown until about 1885 (1)*, when it appeared (probably near Ocala) in what was then the heart of the citrus-growing region, and spread rapidly to all parts of this (3). The first account of the disease was published by F. Lamson Scribner in October, 1886 (1). A fuller account (2), with a colored plate, appeared in the annual report of the U. S. Commissioner of Agriculture for 1886 (pp. 120-121). Scribner described the fungus as *Cladosporium* sp. L. M. Underwood (4), writing in 1891, speaks of it as a widespread disease. A detailed account of the disease and of the fungus was published by W. T. Swingle and H. J. Webber in 1896 (7). They said:

> The introduction of this disease into the United States is comparatively recent. It first appeared in Florida about the year 1884, and spread rapidly over the State and to Louisiana. Although many thousands of trees affected with scab have been sent to California, it seems that the disease is unable to exist there permanently * * *. The malady also occurs in Australia and Japan, from which latter country it was undoubtedly introduced into America.

*Refer to numbers under heading of "References" on pages 841 and 842.

Their investigations with lemon showed that the disease could be controlled by the use of Bordeaux mixture or ammoniacal solution of copper carbonate. They also found that the removal of all infected fruits before the blooming season was highly important.

In Tubeuf and Smith's *Diseases of Plants*, published in 1897, reference is made (p. 509) to Scribner's publication under *Cladosporium elegans* Penz. This is evidently an error (23), as may be seen by examination of Penzig's description and figures in *Studi Botanici sugli Agrumi*, published in 1887. The dimensions of the spores of *C. elegans*

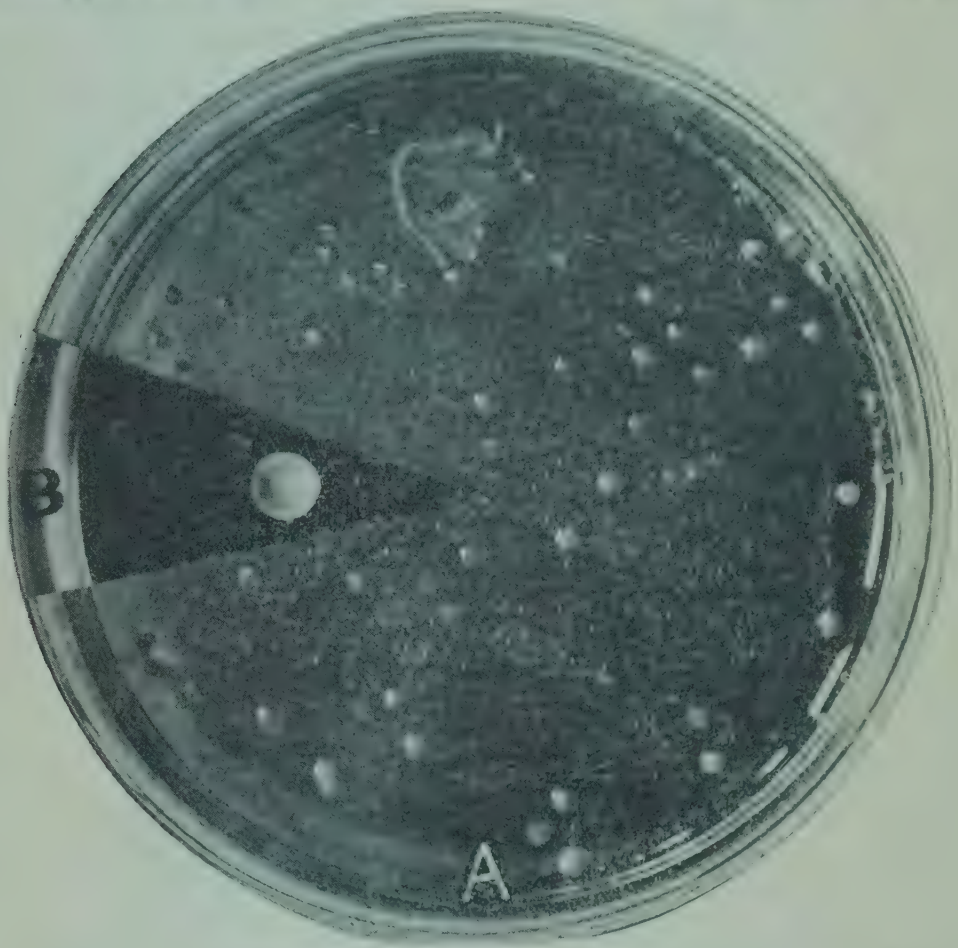

FIG. 256.—Growth of scab fungus on three per cent glucose agar. (A), fifteen days old. (B), maximum growth when not crowded. Natural size.

are too large and the pathological effects on the leaf as figured by Penzig are not the same as those described by Scribner. The spores of *C. elegans* are given as 18 to 20 by 5 to 6, while those of the Scab fungus are 8 to 9 by 2.5 to 4 microns.

G. Massee, in his *Text-Book of Plant Diseases*, published in 1899 (10), described both fungi. On page 310, he described the scab under the name of *Cladosporium citri* "pro tem." and says: "This Cladosporium species is evidently quite distinct from *Cladosporium elegans* Penz. which forms arid brown spots on living leaves of oranges in Italy."

W. T. Swingle in 1897 (8) (then recently back from a trip to Mediterranean countries) said before the Florida State Horticultural Society: "They (the Italians) do not have the dreaded Scab which seems to exist in Florida alone of all lemon-producing countries, although originally introduced from Japan."

Scab was reported in Hawaii (14) in 1905 and in Cuba (15) about the same year.

T. Petch, writing from Ceylon under date of August 20, 1910, says, "Our lime trees are all affected with 'Scab' (*Cladosporium?*), on the leaves especially." Specimens of badly scabbed leaves of citrus were received through H. G. Keppel from Japan in the same year. G. Gandara reports the scab in Mexico in 1910 (25).

The Fungus in Cultures.

The fungus was isolated from sour orange leaves in petri-dish cultures of 2 per cent glucose agar in March, 1906 (18), and since then it has been isolated a number of times both from fruit and leaves. There was first a tortuous growth of minute colorless hyphæ, which soon combined into a kind of stroma. In three or four days the mycelia became visible to the unaided eye. In twelve days the mycelia were 2 to 4 millimeters in diameter, hemispherical and flesh-colored, with a yellowish to reddish-brown tinge (Fig. 256). The central mass became raised, conical, firm and gummy. The margin was fringed by small out-growing hyphæ. Stromas that were not crowded grew to a maximum diameter of 6 to 8 millimeters (Fig. 256, B).

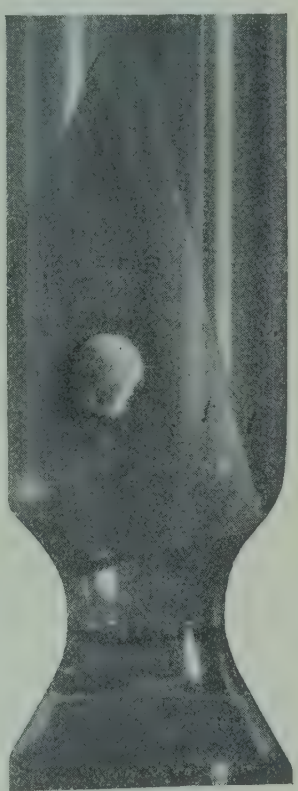

FIG. 257.—Growth of Scab fungus on sweet potato plug.

The mycelia grew differently from and had no resemblance to mycelia of other Cladosporium (such as those of *C. herbarum* var. *citricolum* shown in Bulletin 106, Fig. 23). The central part was made up of close-septate hyphæ in a fairly firm gelatinous mass, from the edges of which extended chains of oval cells, many of them apparently formed by budding. When these gelatinous stromas were transferred to sweet potato plugs, a white downy growth was formed over the surface and on the edges. It was formed by small hyaline hyphæ. This would often disappear and a tough compact stroma be left (Fig. 257). The fungus did not usually spread out much over the surface of the medium, but piled up in time into wrinkled tough masses. When transferred to sterilized leaves or stems, more of the looser less-septate hyphæ were developed. If these stromas were kept growing for some months, and then gradually allowed to dry out, there were formed

compact masses made up of thick-walled colored packet-like clusters or chains of cells. In one case it was found that growth took place from a culture four months old which had thoroughly dried out. Another culture, which had been made on November 16th and had dried out, was dropped on to an agar tube medium on June 8th of the following year, and developed a pure culture by contact. On January 2d of the second year, this culture, which had also dried out, was dropped on to a sweet potato plug and produced a pure growth; thus making two periods, one of about seven months, and the other of about six months, between transfers. Some attempts were made to get growth from twelve to fourteen months old, but no growth of the fungus was evident.

The same thick-walled packet forms of cells that were seen in old cultures were found in old warts and scabs that had wintered over on the trees. It is unnecessary to assume that the fungus need have any other form of reproduction to enable it to live over from one season to another. Search for other forms of reproductive bodies, and several attempts to develop a perfect stage by placing scabbed fruit and leaves for a long time in sand under different conditions failed to show any new forms of spores.

Germination of Spores.

The spores of this fungus germinated readily in hanging drops of tap-water, 3 per cent glucose and orange-leaf agar. They began to

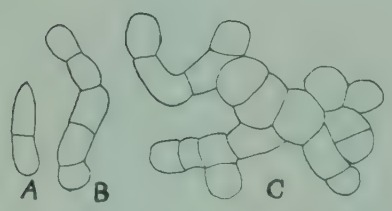

FIG. 258.—Spores germinated in water. (A) and (B) after twenty-four hours. (C) after three days. Magnified 500 times.

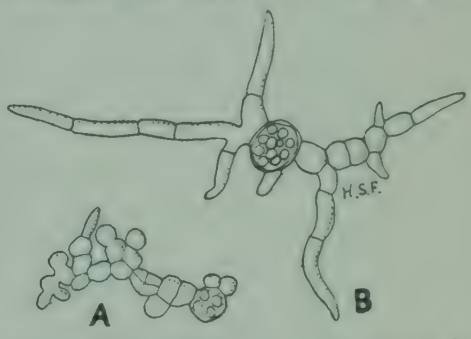

FIG. 259.—Growth of two spores in orange-leaf agar after three days. (A) Budding form. (B) Elongated hyphæ. Magnified 375 times.

germinate in from five to twenty-five hours. In water, new short rounded cells were formed immediately from the original spore of about the same size. Later an irregular body of constricted cells, with oval or spherical conidial cells at their projecting ends, was formed (Fig. 258). In glucose, the germination began about as in water. As growth proceeded a mass of coalescing thick-walled short septate cells formed, with looser vegetative hyphæ radiating from the central part. With age the protoplasm of some of the cells seemed to be concentrated in a body or bodies

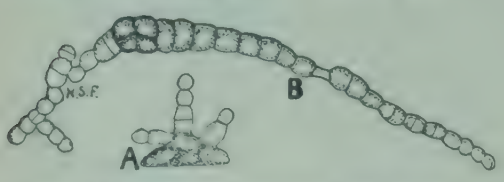

FIG. 260.—(A) Conidia from edge of stroma on glucose agar. (B) Thick-walled spore-like cells from culture one year old.

resembling spores. Fig. 259 shows two forms of growth in orange-leaf agar, one of which (A) appeared to be formed by budding as in Saccharomyces. Spore-like bodies inside some of the cells were also common.

Infection Experiments.

Several successful infections were made from inoculations with pure cultures of this fungus. A number of complete failures in causing infection were at first experienced. It was found that under ordinary conditions the disease would not spread naturally in the greenhouse. Small sour orange trees badly infected with scab were brought into the greenhouse. As new growth came out, it was invariably free from scab, even when similar plants remaining outside continued to show scabs on the leaves and young twigs. Some infection was produced in the greenhouse by inoculation with cultures, but the scabs thus formed did not communicate the disease to subsequent new growth.

On August 25, 1906, nine small sour orange trees, which had been cut back and were coming into new leaf, were treated by spraying with cultures shaken up in distilled water; nine similar plants were treated by putting on the culture with a camel's-hair brush; and nine others were treated by putting on spores from infected leaves shaken up in water; while eleven others were kept untreated as checks. None of these thirty-nine plants showed any infection, and they continued to remain free from scab as long as they were in the greenhouse.

In November, 1908, five different trees were inoculated in the greenhouse by puncturing the young rapidly growing leaves and twigs and placing in them portions of cultures fourteen days old. These twigs were then wrapped in paraffined paper, which was taken off after twenty-four hours. In about fifteen days characteristic diseased areas had developed. Noticeable irritation of the punctured points had started before that time. The scabs were produced both on the twigs and on the leaves. (Checks not inoculated were not at all infected.) The leaves became wrinkled and contorted just as in case of natural infection. In about sixty days the diseased warts were hard and corky and fully matured, but while the plants remained in the greenhouse no new points of infection developed.

On January 6, 1909, six sour orange trees were sprayed with cultures two months old which had developed on sterilized orange twigs. The cultures were mashed up in distilled water and sprayed on with a large atomizer. Two of the six trees were covered with bell jars. The others were left uncovered. All the trees were growing rapidly and bore many tender twigs and leaves. In six days there were small infection points to be seen on the leaves of the two trees under bell jars. In one month all the trees showed more or less infection. Those which had been under bell jars when inoculated were badly infected. Those uncovered were only slightly infected with the scab. Check trees not inoculated showed no signs of the disease. Later observation showed that there was no spread from these first scabs to the new leaves that came out later.

Experiments for Control.

In 1896, Swingle and Webber reported that their experiments had shown that either Bordeaux mixture or ammoniacal solution of copper carbonate was effective in controlling scab.

In the fall of 1909 and spring of 1910, the writer conducted some spraying experiments on the Experiment Station grounds with Bordeaux mixture and various strengths of Avenarius' carbolineum. It was found that weak Bordeaux mixture was more effective than any mixture of carbolineum up to 25 per cent.

In September, 1909, small sour orange trees which were badly affected with scab were sprayed with Bordeaux. Others next to them were left as checks. All the trees put on some new growth. The new growth on the sprayed trees was healthy and vigorous, while the growth on the unsprayed trees continued to show infection. These lots were contiguous to one another, there being a space of only six inches between them. As would be expected, a little infection came over from the unsprayed lot on growth which came out after the spraying was done; but the effect of the spraying was quite marked.

In March, 1910, half of the trees sprayed in September, 1909, were sprayed with Bordeaux for the second time, and half of the check trees were sprayed with Bordeaux for the first time. The effect of the Bordeaux was again quite apparent. Those trees sprayed in November and March had their leaves entirely free from scab. On those sprayed only in November the lower leaves were free from scab, while the upper and new growth was affected. On those sprayed only in April, the lower old leaves of the summer before were badly scabbed, while the upper leaves that were rapidly growing at the time of the spraying were free from scab. Those not sprayed at all showed scabs on leaves and on twigs all the way out from the oldest to the newest growth.

At the same time a number of the larger trees on the Experiment Station grounds were sprayed with Bordeaux, and others near them left as checks. While the growth subsequent to the spraying showed no infection for at least two months, the unsprayed trees showed considerable infection on the growth of the same age.

Mr. H. B. Stevens, an orange grower at DeLand, reported that he had been successful in preventing the spread of scab on grapefruit by pruning off and destroying all the infected growth as soon as it appeared. This was made possible by the fact that the scab began on certain branches and not all over the tree at once. When this was pruned off, the subsequent new growth came out entirely free from the disease. To test this method further, the writer, in March, 1910, pruned off all the growth showing scabs on a row of sour orange trees on the Experiment Station grounds. Later observations of the fresh new growth following this pruning showed that it was nearly free from scab for at least two months. On new growth later in the year some infection occurred, probably from other trees which were left as checks in another part of the grounds not far distant from the pruned ones.

Those unpruned continued to show scabs on the leaves as fast as the leaves unfolded.

Preventive Measures.

1. **Destroying All Sour Orange or Other Worthless Growth.**—All sour orange or lemon sprouts in an orange or grapefruit grove should be cut out and destroyed, as they are almost always badly infected year after year, and are a constant source of danger to the grapefruit and other varieties which are usually less susceptible. All scabbed sour oranges and worthless lemons or other scabby fruits should be picked up and destroyed.

2. **Spraying When Necessary.**—In case of a severe outbreak of scab that must be checked at once, spray with ammoniacal solution of copper carbonate (3 pints ammonia and 5 ounces of copper carbonate to 50 gallons of water) or Bordeaux mixture (3-3-50). The copper carbonate solution is to be preferred, since it usually does not cause so great an increase of scale insects as does Bordeaux. In bad attacks, the first spraying should be done soon after the petals fall, and a second may be necessary two weeks or a month later. A third spraying will probably not often be necessary. In many cases of light attack, the loss by the scab is less than the cost of spraying with the fungicide and following it up with an insecticide.

3. **Cutting out Scabby Growth.**—New growth coming out at unseasonable times, and the late bloom (known as "June bloom") are most apt to be infected. Such infected growth can be pruned out and destroyed. This will help to prevent a recurrence of the disease.

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A FEW FACTS CONCERNING THE FRUIT FLIES OF THE WORLD. II.

By George Compere.

Observations in Palestine, Egypt, and Malta.

The olive fly (*Dacus oleæ*) is also present at Jerusalem, but for some reason it did not appear to be so destructive at that point as in other sections of the Mediterranean countries. Some of the old residents there informed me that as a rule from 15 to 25 per cent of the olive crop is annually destroyed by the fly. It was at Jerusalem that I first discovered the fact that the olive fly maggot does not always enter the soil to pupate, but will often pupate inside the withered fruits which have been destroyed. As a rule there are only one or two maggots in a single fruit — more often only one.

At one of the native fruit shops in Alexandria, Egypt, I found a small fruit, in appearance very much like our cherry plum, infested with three fruit fly maggots. These maggots pupated before I reached Port Said. I then destroyed two of these and kept one, as I did not care to travel around with more than a single specimen, there being danger of escape and the possibility of establishing a pest in another locality, which could not happen with a single fly. From this maggot secured at Alexandria I reared a fruit fly which was identified at the British Museum as *Dacus longistylus* Wied.

On the island of Malta *Ceratitis capitata* has been a most serious pest ever since 1870, and the Governor of the island in 1887 appointed a royal commission to investigate and discover if possible some method of control. After a very exhaustive investigation this commission failed to discover any method by which the fly could be controlled, and advised that the destruction of all fallen fruits would most likely be of some assistance in reducing the pest. I did not make any pretense of investigating the fly during my short stay at Valetta, as there would be no possible chance of any effective natural enemy being found where the fly was such a pest as it is there.

From September 1, 1904, up to January 1, 1905, my time was employed collecting the parasite of the codling moth in Spain for California.

Searching for Fruit Fly Parasites in Brazil.

When I arrived in San Francisco on January 29, 1905, I was instructed by Mr. Ellwood Cooper to make another trip to Brazil to collect Brazilian fruit fly parasites and predatory beetles for West Australia, as the first lot which was taken to that state had not established themselves, there being no maggots at the time the beetles were liberated, and the braconid parasites which had been kept in cold storage were so feeble when they issued that they died in a few hours afterwards.

March 19, 1905, I arrived at Bahia for the second time and found Mr. Charles P. Lounsbury, Government Entomologist of the Cape of Good Hope, who explained that on the strength of the report of my first visit to Brazil, which was published in the August, 1904, issue of the Journal of Agriculture for West Australia, Mr. Claude Fuller, the Natal Government Entomologist, and himself had been instructed by their respective governments to proceed to Brazil and secure some of the parasites and predatory beetles which I had mentioned in my report. He also informed me that Mr. Fuller had already returned to Natal after remaining about thirty-five days at Bahia, while he himself had visited Sao Paulo, and that he was leaving the same day and would have only about two hours longer to remain with me. He did not consider that the results of their investigation would warrant the canceling of his steamer ticket. He was quite sure that *Ceratitis capitata* did not occur at Bahia; that the Staphylinid beetle mentioned in my report was not to be found at that season of the year and could be of very little value in destroying the fruit fly, as they had made a most careful search for it and failed to even find a single specimen. The Braconid parasites were the only natural enemies of the fruit flies that they had been able to locate.

I was astounded at these statements and urged Mr. Lounsbury to remain a few days longer at Bahia and said that I would show him the Staphylinid beetle and also *Ceratitis capitata* if he would do so. Dr. Furniss, the American Consul at Bahia, also a naturalist, had been out in the orchards and gardens in company with Messrs. Lounsbury and Fuller and could not find a single trace of the Staphylinid beetle or the Mediterranean fruit fly, and during all the years he had lived at Bahia he stated he had never heard of their being there. He thought possibly that they were only to be found at certain seasons of the year, and that I had happened to be there just at the time they were present.

I assured them that I had returned to secure another lot of the Staphylinid beetle for West Australia and that I would remain about twelve days, and expected to be able during that time to collect thousands of the beetles, and would very much like to show that there were plenty present in every garden or orchard where there was fruit in and around Bahia. Dr. Furniss alone agreed to accompany me in the investigations and we selected the Pinto orchard, which was the largest orange grove in that vicinity.

In the Hawaiian Islands there have been found to be thirty-five or more hosts of the fruit fly. Making a corresponding list for California, there are not more than ten or fifteen in any one section of California that are similar enough to be possible hosts. At any time of year in Hawaii, there are at least two wild and five or six cultivated fruits

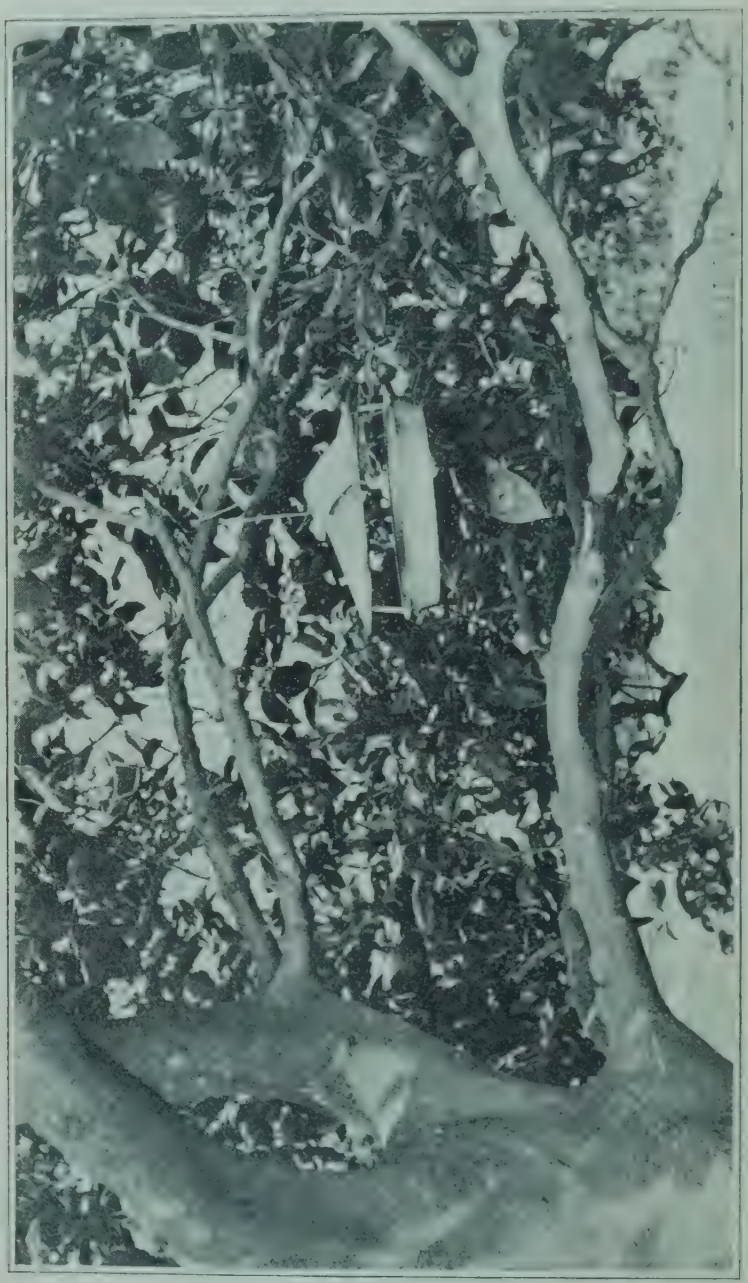

FIG. 261.—Kerosene trap suspended in an orange tree.

which breed the fruit fly, while in California, with the possible exception of San Diego County, there are at least a couple of months in the year when no possible host plants are in bearing.

In Hawaii the commercial value of the fruits injured could be computed in the hundreds of dollars, while should it become established in

California the damage would be counted by the hundreds of thousands. In Hawaii the commercial crops are sugar, canned pineapples, rice and bananas. As a country it cannot be vitally interested in the control of the fruit fly. In California the backbone of its industry is fruit.

In Hawaii none of the host fruits are produced commercially, *i. e.*, in orchards where modern apparatus for artificial control can be used. In California, the mainstay of our fruit industries lies in well-planned, well-laid-out orchards with well-organized methods of culture.

In Honolulu during the year 1910 there was a variation in temperature of 18°, the range being 67° to 85°. This condition is ideal for the propagation of the fruit fly. In no place in California can parallel or near parallel climate be found.

The results of experimentation using artificial means of control are as follows:

The kerosene trap is of slight value for control purposes, as the females caught are very few and the sphere of influence is limited, being possibly fifty feet or so, varying with the wind, freshness of kerosene, etc. This was shown repeatedly from the fact that where traps were placed in trees on each side of a yard the numbers of flies caught per day in one was often double or even three times those caught in the other. Also, on changing the trap from one tree to another at a little distance, the number at once would jump higher, showing that probably only those flies, hovering in the immediate vicinity, or emerging from the ground had been caught. Again, one yard would show an abundance of flies while another a hundred yards or so away would show few. This, however, could nearly always be traced to some fruit trees which had been infested and from which the fruit had not been picked and destroyed. It was found, however, that it was not necessary to place traps in trees bearing fruit to get results, for some were captured in all varieties tried, save only the banana, although the number varied with proximity to fruit, bushiness of tree, etc. In general, however, the traps serve to compare one locality with another and one time with another, thus being a valuable asset. During the last season the greatest number of male flies caught in a day in a single trap was 164, while the average was nearer 30.

Spraying with Poisoned Bait.

Spraying as a means of control was not from the first believed to be the method on which hopes for the greatest results could be based, owing to the mechanical problems, etc. However, it was thought well to leave no stones unturned, and tests were subsequently made in this line.

The only authority we had on the use of poison bait for the fruit fly was Mally of South Africa. He advocated a spray made from

4 ounces arsenate of lead
3 pounds sugar
5 gallons water

This mixture was tested but immediately it was found that the grade of sugar purchasable here (4 x) was not comparable to the ordinary low grade brown sugar which contains much molasses and which undoubtedly was referred to by Mally. The result was that twelve to twenty four hours after the spray was applied, the water evaporated,

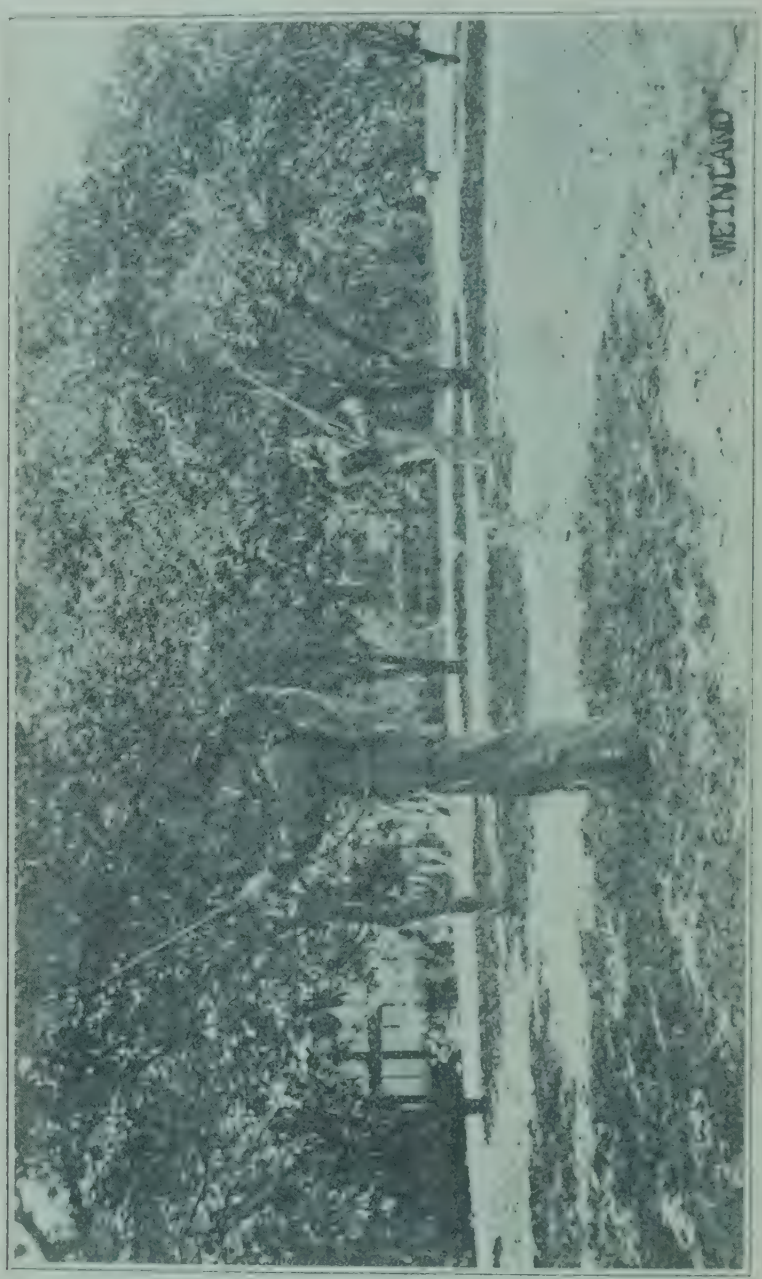

FIG. 262.—Applying poisoned sprays with knapsack sprayers in the experimental work

leaving the sugar in a crusted condition on the leaves, a form in which its value as an insecticide was probably worthless. Molasses was then tried. As this would remain in a viscous condition for some time, it was thought that it would prove to be much better. Two grades of molasses were available here, New Orleans, costing about 40 cents a gallon, and the refuse molasses of the sugar plantations at about 4

cents. The New Orleans grade undoubtedly has the greater sugar content, and consequently would probably attract the flies better, yet its comparative cost brought the other grade up for investigation. This plantation molasses contains only 4 or 5 per cent available sugar, yet the remaining materials are more or less sweet and sticky. Brown sugar was then combined with this grade of molasses and the formula was then revised to read,

Lead arsenate (paste)	3½ pounds
Brown sugar	10 pounds
Plantation molasses	5 gallons
Water	50 gallons

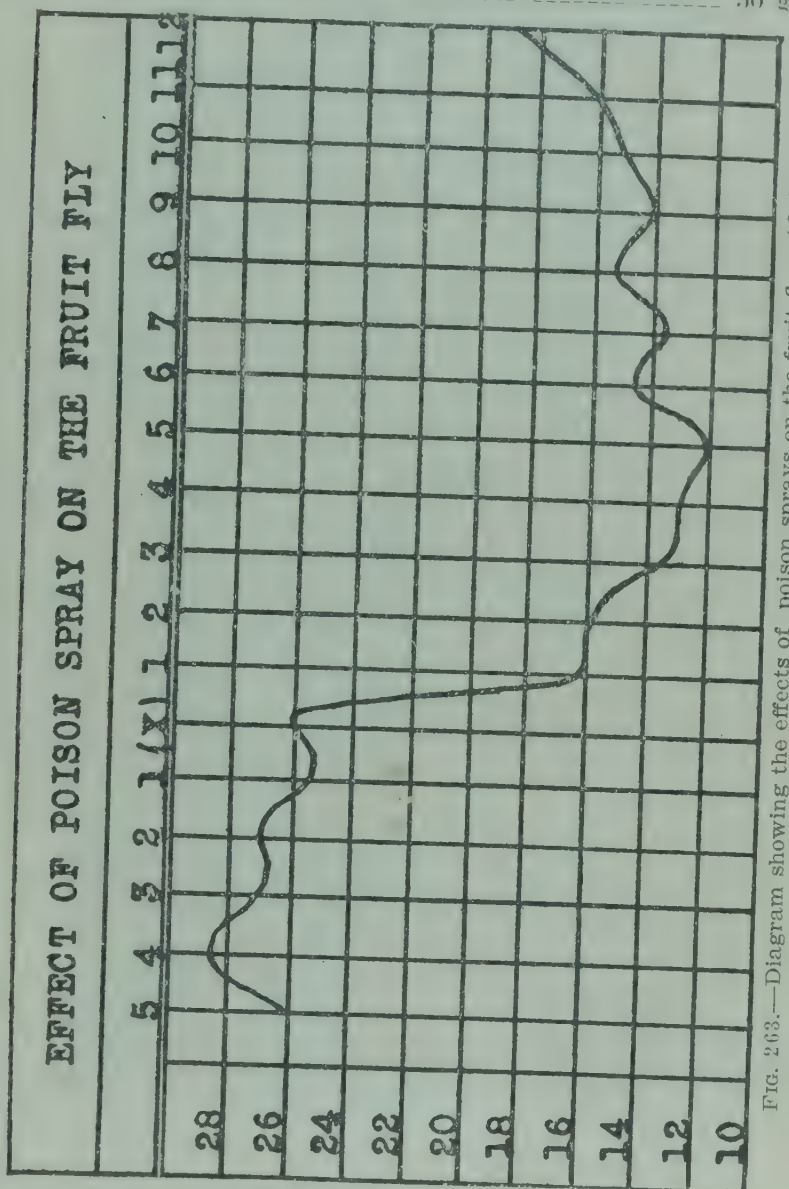

FIG. 263.—Diagram showing the effects of poison sprays on the fruit fly. (Original.)

It must be remembered that the natural features of the district and house yards did not admit the use of power outfits. The consequence was that knapsack and other easily transported and manipulated sprayers had to be resorted to. The kind shown in Fig. 262, with the shoulder pump, using a vermorrel nozzle, was tried with success.

This mixture was tested but immediately it was found that the grade of sugar purchasable here (4 x) was not comparable to the ordinary low grade brown sugar which contains much molasses and which undoubtedly was referred to by Mally. The result was that twelve to twenty four hours after the spray was applied, the water evaporated,

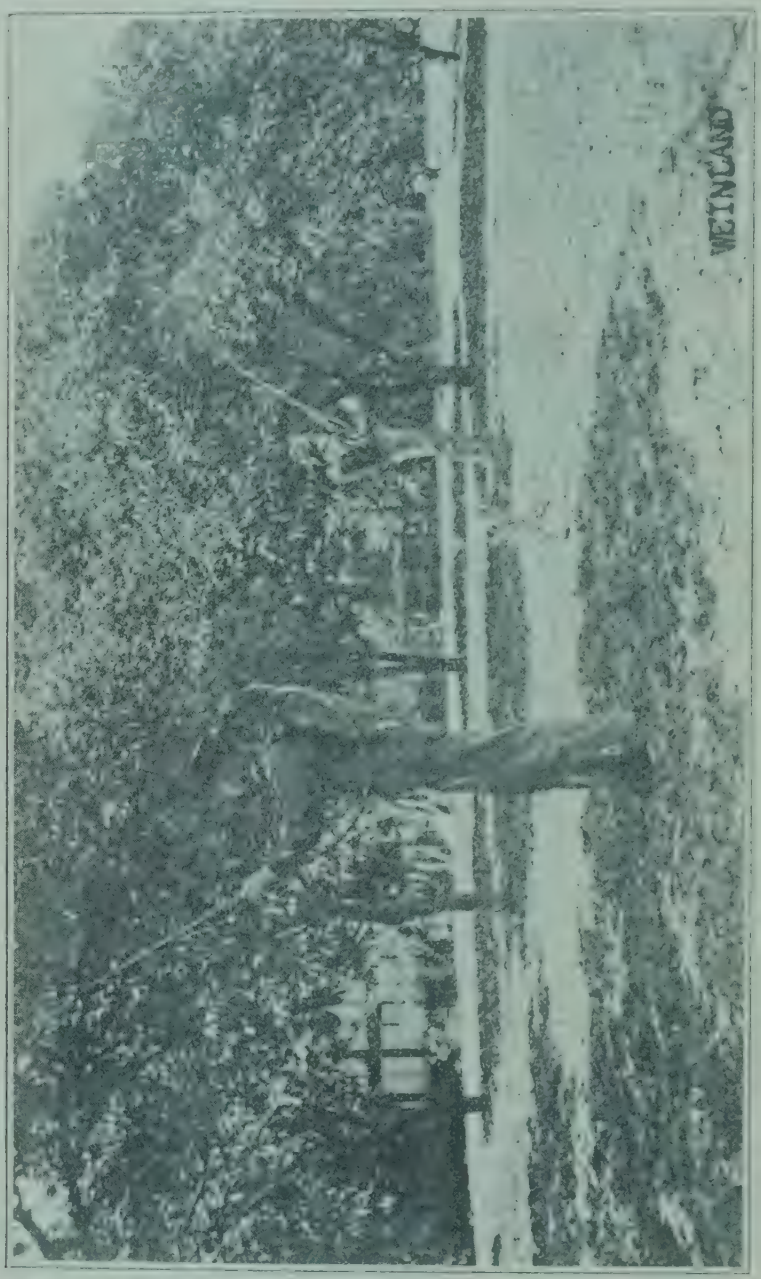

FIG. 262.—Applying poisoned sprays with knapsack sprayers in the experimental work.

leaving the sugar in a crusted condition on the leaves, a form in which its value as an insecticide was probably worthless. Molasses was then tried. As this would remain in a viscous condition for some time, it was thought that it would prove to be much better. Two grades of molasses were available here, New Orleans, costing about 40 cents a gallon, and the refuse molasses of the sugar plantations at about 4

cents. The New Orleans grade undoubtedly has the greater sugar content, and consequently would probably attract the flies better, yet its comparative cost brought the other grade up for investigation. This plantation molasses contains only 4 or 5 per cent available sugar, yet the remaining materials are more or less sweet and sticky. Brown sugar was then combined with this grade of molasses and the formula was then revised to read,

Lead arsenate (paste)	3½ pounds
Brown sugar	10 pounds
Plantation molasses	5 gallons
Water	50 gallons

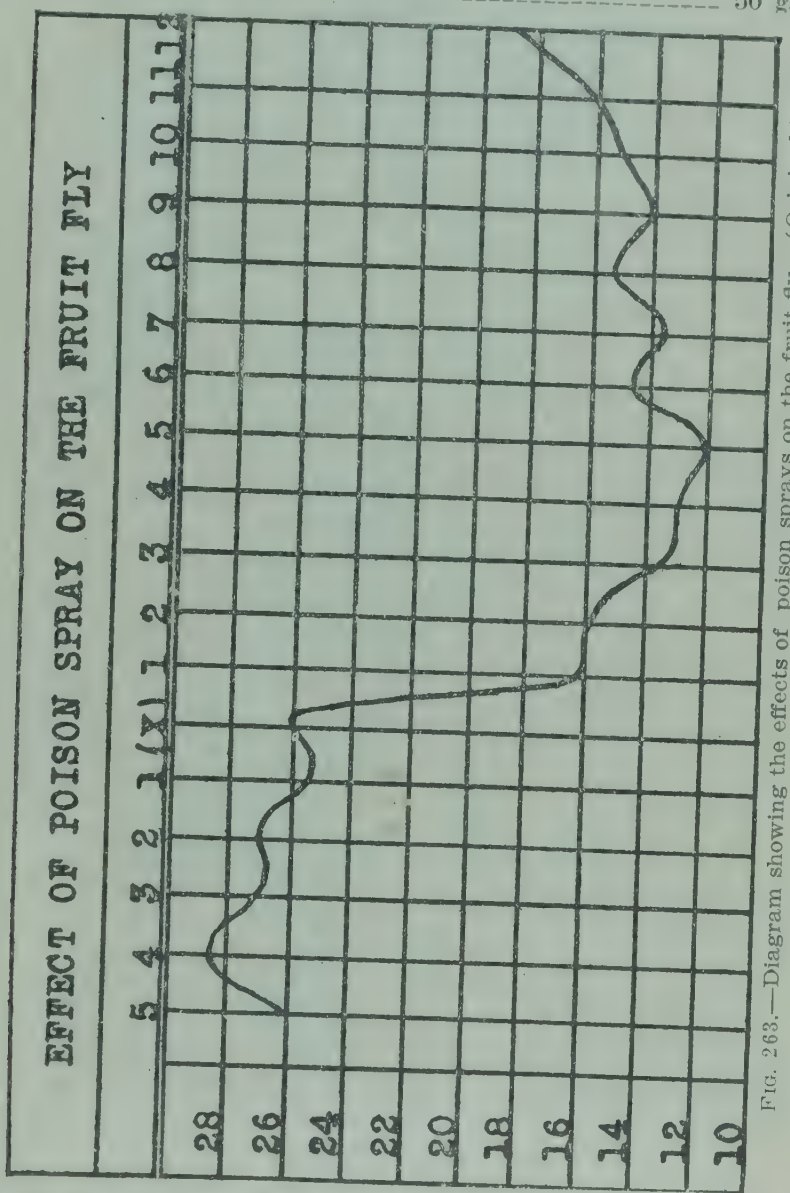

FIG. 263.—Diagram showing the effects of poison sprays on the fruit fly. (Original.)

It must be remembered that the natural features of the district and house yards did not admit the use of power outfits. The consequence was that knapsack and other easily transported and manipulated sprayers had to be resorted to. The kind shown in Fig. 262, with the shoulder pump, using a vermorrel nozzle, was tried with success.

A word about how this spray was applied and its value. It was impossible to spray higher than 10 feet or so with this outfit, and with the limited means it was not thought advisable to spray all cultivated vegetation, so the low host trees, as the oranges, etc., only were sprayed. The question might be asked, how do you know whether the spray kills

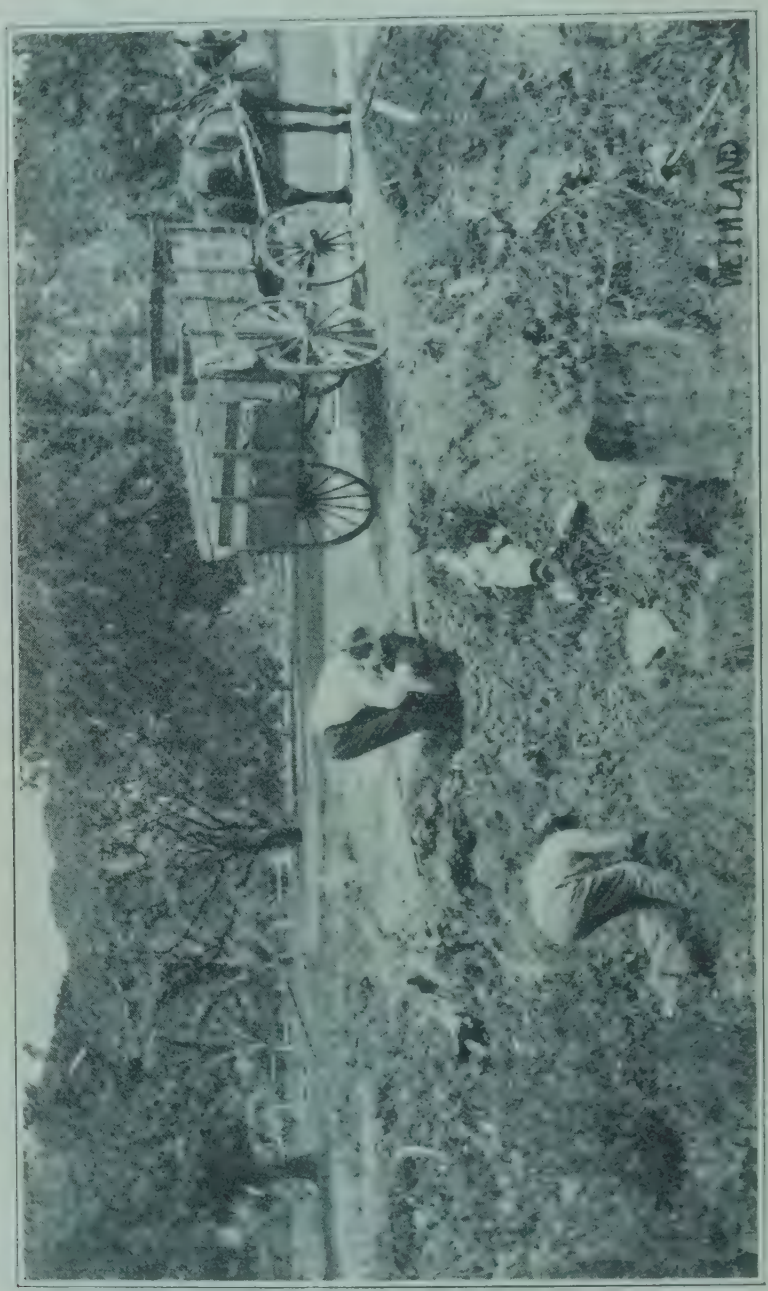

FIG. 264.—Inspectors cleaning up a bad mango dump.

the flies or not? It was impossible to find the remains of flies under the trees due to the rapid work of ants, and though in the laboratory flies would die in 36 to 48 hours after being confined in jars with freshly sprayed leaves, this was thought not a sufficient test. The following diagram (Fig. 263) will serve to show the results compiled as the average of seven traps in several different parts of the quarantined area.

The numbers to the left represent the number of flies per trap per day, and those above the days before and after spraying. The figure (x) shows the time the spraying was done. From the shape of the curve it is apparent that there is a marked but temporary reduction in the number of flies caught.

The lowest point comes about five days after spraying, after which time the spray becomes ineffective and flies coming in from outside sources raise the number again.

It is necessary to note in connection with the above diagram that all the traps were hung in orange trees, both because they were easy of access and because they had previously proven to yield the greatest number of flies.

FIG. 265.—Clean culture inspectors. In choosing these men account is taken of their familiarity with the languages and habits of the people as well as their knowledge of the many crooked streets and lanes in Honolulu.

In spite of the apparently good showing of the spray, as seen by the diagram, we must remember that this represents only one style of tree, namely, the low host tree, and especially the orange. The question then comes, what effect does the spraying of low trees have upon the flies in the tall ones? A test was made of this and it was found that spraying low host trees had apparently little effect upon the taller trees, especially if the latter were in bearing. To make this work more efficient, a 10 foot spraying rod was adopted to enable the lower parts of the taller trees to be reached. It is found that if the pressure is kept at 40 or 50 pounds and the wind made use of, the spray will be broken up into minute drops, which fall like mist on the exposed leaves. This

is necessary if the drops are too large, because the lead arsenate, being the heaviest material in the spray, runs to the bottom of each drop, leaving a considerable portion of the spray unpoisoned.

There is one serious drawback, however, to this method. The molasses being sweet, and remaining for a time on the trees, allows the growth of fungi, similar to that growing on the sticky substances secreted by coccids. These black fungi become more noticeable after several sprayings, interfering, of course, somewhat with the best growth of the tree.

Conclusions.

The fruit fly will always be in Hawaii. Should an effective parasite be found, the best it could do would be to keep it under control. Artificial control methods, particularly spraying, would be of much greater value in California owing to the differences in the conditions mentioned. Effective quarantine is our greatest hope for keeping out this most serious pest.

ROADSIDE TREES.

By W. Vortriede, Head Gardener, Capitol Park, Sacramento, California.

No road can be considered entirely finished until it is lined on both sides with a row of suitable shade trees. The action of wind and sun is moderated by the shelter and shade of the trees which keep the roadbed in better condition. But the greatest benefit is the agreeable shade large trees afford the traveler on hot summer days. A well kept tree-lined road also adds much to the landscape. These greatly enhance the value of the adjoining property.

In all our efforts to raise the permanent value of a landscape we must consider the fitness of its improvement; so with the planting of shade trees on our roadsides.

In planting the roadsides we must see that the right kind of trees are selected. For instance, it would not do in our country to line them with large shade-making fruit trees bearing valuable fruits, such as good varieties of apple, pear, cherry, walnut, etc.; while trees bearing fruits of little value, except for the birds, might be of great value in some localities. Then again, central and especially northern California should not follow the example of southern California too closely, by planting almost exclusively evergreen trees, because the southern part of the State is more semi-tropical by its geographical position and environment. Evergreen and tropical looking trees are quite an asset to draw and keep winter sojourners there.

Deciduous trees are by far the most appropriate for roadside planting. Their delicate spring foliage and rich autumn tints are seldom equaled by evergreens. The great advantage of allowing the sun to shine on the roadbed in winter, thus enabling same to dry out more readily after rainstorms, is decidedly in their favor.

The varieties of trees to be planted must be determined by the kind

of soil: the condition of available moisture; if irrigating can be done, or if moisture must be furnished by tank wagon; how low the temperature falls in winter, and how high a mark is reached in summer; also how strong the prevailing winds. Trees in windy positions must be pruned the first four or five years to make them strong.

All trees should be planted carefully. A strip of ground at least ten feet wide should be plowed deep and harrowed and in the center of this the holes, at least three feet in diameter and two feet deep, dug for the trees. All trees should be guarded against stock browsing, and three feet or more of the limbs whitewashed to prevent sunburn. The soil around the trees should be worked after each irrigation to prevent baking and the rapid loss of moisture.

Large wide-spreading trees should be planted from forty to sixty feet apart, middle sized trees from thirty to forty feet apart, small trees and palms from twenty-five to forty feet.

Large Deciduous Shade Trees.

Large, shade-making deciduous trees which will grow in almost any kind of soil and in any part of California, with small amount of moisture and the least care are as follows:

Ulmus alata. Winged Elm.
Ulmus campestris. English, French or European Elm.
Ulmus campestris clemmeri. Belgian Elm.
Ulmus campestris cornubiensis. Wheatley's Elm.
Ulmus campestris cucullata. Hooded Elm.
Ulmus campestris monumentalis. Monumental Elm.
Ulmus crassifolia. Cedar Elm.
Ulmus scabra. Scotch or Wych Elm.
Ulmus scabra dovæi. Dovæ's Scotch Elm.
Ulmus scabra huntingdoni. Huntingdon Elm.
Ulmus suberosa. Cork Elm.
Populus deltoides carolinensis. Carolina Poplar.
Juglans californica. California Black Walnut.
Robinia pseudacacia. Black Locust.

Deciduous trees of large size, fine shade, doing well under ordinary care, with plenty of water.

Quercus lobata. California Weeping or Valley Oak.
Quercus macrocarpa. Bur Oak.
Quercus nigra. Water Oak.
Ulmus americana. American or White Elm.
Catalpa speciosa. Hardy Catalpa.
Liriodendron tulipifera. Tulip Tree.
Acer saccharinum. Silver Maple. Soft Maple.
Acer saccharinum wieri. Wier's Cut-leaved Maple.
Fraxinus americana. American White Ash.
Gleditschia triacanthos. Common Honey Locust.
Populus alba bolleana. Bolles Poplar.
Platanus orientalis. European Sycamore.
Gingko biloba (Salisburia adiantifolia). Maiden Hair Tree.

Small Deciduous Shade Trees.

Small and medium sized deciduous trees doing well under ordinary care with sufficient water.

Melia azedarach umbraculiformis. Texas Umbrella Tree.
Zelkova acuminata (Zelkova kaki). Japanese Elm.
Sterculia plantanifolia. Chinese Parasol Tree.
Sophora japonica. Pagoda Tree.
Morus alba. White Mulberry.
Morus nigra. Black or Russian Mulberry.
Catalpa bignonioides.
Kohlreuteria paniculata. Japanese Varnish Tree.
Albizzia julibrissin (Acacia julibrissin).
Acer negundo. Box Elder.

Large Evergreen Shade Trees.

Large evergreen shade trees, doing well under ordinary care and watering.

Eucalyptus gunni. Cider Gum.
Eucalyptus globulus. Blue Gum.
Eucalyptus polyanthema. Red Box. Australian Beech.
Eucalyptus resinifera. Red Mahogany.
Eucalypius rostrata. Red Gum.
Eucalyptus rudis.
Eucalyptus tereticornis. Gray Gum. Flooded Gum.
Eucalyptus viminalis. Manna Gum.
Acacia melanoxylon. Black Acacia.
Magnolia fœtida (grandiflora). Magnolia, Bull Bay.
Quercus agrifolia. California Live Oak.
Quercus ilex. Holly Oak.
Quercus suber. Cork Oak.

Small Evergreen Shade Trees.

Small and middle-sized Evergreen trees doing well under ordinary care and watering.

Sterculia diversifolia. Bottle tree of Victoria.
Acacia baileyana.
Acacia dealbata. Silver Wattle.
Acacia decurrens. Black Wattle.
Acacia mollissima. Green Wattle.
Camphora officinalis. Camphor Tree.
Ceratonia siliqua. Carob Tree.
Prunus integrifolia. Catalina Island Cherry.
Ligustrum amurense. Amoor River Privet.
Ligustrum japonicum. Japanese Privet.
Arbutus menziesi. Madrone.
Shinus molle. Pepper Tree.
Photinia serrulata. Photinia.
Pittosporum eugenioides.
Olea europæa sativa. Olive.

Ornamental Palms.

Palms, ornamental for roadside.

Washingtonia gracilis. California Fan Palm.
Washingtonia robusta. California Fan Palm.
Phœnix canariensis. Canary Island Date Palm.
Phœnix tenuis. Date Palm.
Jubœa spectabilis. Wine Palm.
Erythea edulis. Guadalupe Island Fan Palm.
Trachycarpus excelsus. Windmill or Japanese Fan Palm.

Native Shade Trees of California.

California native trees, which ought to be planted more. Nearly all need good care.

Quercus agrifolia. California Live Oak.
Quercus densiflora. Tanbark Oak.
Prunus integrifolia. Catalina Evergreen Cherry.
Arbutus menziesi. Madrone.
Umbellularia californica. California Laurel.
Quercus californica. Black Oak.
Quercus douglasii. Blue Oak.
Quercus garryana. White Oak.
Quercus lobata. Valley Oak.
Juglans californica. California Black Walnut.
Acer macrophylla. Oregon Maple.
Cornus nuttallii. Nuttall's Dogwood.

THE SEPTEMBER CROP REPORT.

By G. E. Merrill.

Apples. In spite of a material decline in crop prospects since the issuance of our August report, this year's crop of apples in California will be greatly in excess of last year's. The excessive heat in early September caused considerable loss, especially in the Watsonville district, reducing the quality of salable fruit by at least 10 per cent.

Not much change has developed in the apple situation outside of California. In the North Atlantic division of states, including New York and Pennsylvania, heavy producers of apples, the crop promises to be slightly less than last year, or 5 per cent better than normal. In the South Atlantic division it promises to be nearly twice as great. In the Central States, east of the Mississippi, it is about 10 per cent less than last year's crop. Throughout the rest of the country, except in Minnesota, Iowa and South Dakota, the crop will be somewhat heavier than last year. A particularly good crop is promised in Oregon, Washington and Idaho.

Grapes. As indicated in our previous reports, the wine grape crop is materially lighter this year than last, except in Fresno County, where it promises to be 15 per cent heavier. The crop of table and raisin

grapes is also light and while early reports of rain damage may have been exaggerated, enough damage was done to cause considerable loss. Fresno, Tulare and Sutter counties report raisin grape crops of less than 75 per cent of last year's.

Lemons. The lemon situation appears to be unchanged, or about 80 per cent of normal, except that an unusually fine setting of winter and spring fruit is reported from Ventura County.

Olives. As previously reported, the olive crop is extremely light. A crop less than half as large as that of last year will be harvested.

Oranges. The navel orange outlook appears good, except in the Porterville district and in sections severely injured by frost last winter. Los Angeles County reports prospects of a full crop or an improvement of 10 per cent over last month's indications. Tulare County reports a crop of not over 50 per cent of last year. This shortage is due to the severe drop of last June.

Very good reports have been received on the Valencia outlook from Orange County. Ventura County reports an average promise of Valencia.

Prunes. The prune situation appears unchanged, except that some damage from rain is reported from Sonoma County. Outside of Santa Clara County good crops are promised. In Solano County a fine crop of good-sized fruit is reported. The Santa Clara Valley crop is variously estimated at from 65 to 100 per cent of last year's crop, the smaller estimates being made by the growers and the larger ones by the packers.

Walnuts. Little of interest regarding walnuts has developed during the past month, except that the drop has been bad in Santa Barbara County. Not over 60 per cent of a crop is now promised from that district, while the general average for the State is from 75 to 80 per cent.

*DATE GROWING IN CALIFORNIA.

By Paul B. Popenoe, Altadena, Cal.

Early History.

So well adapted is the date palm to culture in certain parts of the southwest that ever since attention was widely called to it, a decade ago, it has been looked upon as the most promising industry there. The hopes of that period have now been changed to certainties, by the work of many experimenters, so there remains no doubt as to the possibilities of this culture. For the Coachella, Imperial, Chuckwalla, and Palo Verde valleys and certain low-lying parts of Arizona, there is no uncertainly about the production of dates; it is admitted to be one of the most desirable industries in which ranchers can engage. The areas

*Note.—An article entitled "The Production of Dates in California" was written by Mr. Popenoe and published in the proceedings of the Forty-first California State Fruit Growers' Convention, which was issued as No. 9 of The Monthly Bulletin. Reprints of this article are still available.—Editor.

named are not large in total extent, but they probably exhaust the list of good date regions in the United States, if a little strip of Texas in the neighborhood of Laredo, where the government has recently started encouraging experiments, be added.

Eventually, it will no doubt be possible to grow certain varieties of dates in other parts of California. Seacoast varieties can probably be found which will succeed in such a climate as San Diego, while there are plenty of early-maturing sorts that will doubtless fruit with fair regularity in parts of the San Joaquin Valley, the Sacramento Valley, Death Valley and similar locations, warm in summer but cold in winter. These last-named areas will not be likely to affect the market in dates; they will grow fresh fruit for home consumption, but can hardly produce enough high-grade dates to create much of a commerce, since the best varieties usually ripen rather late because they require a great amount of total heat to mature properly. This, at least, is the case with North African varieties; it is possible that the early-ripening Persian Gulf dates may change the situation entirely, but as they have not yet been tried in such regions as I have mentioned, one can only speak from conjecture.

Attention was first called to date culture as a possibility for the southwest by the fruiting of a number of scattered seedlings, notably those planted by J. R. Wolfskill near Winters, Yolo County, about 1858; a few in the neighborhood of Yuma, and still others in the Salt River Valley of Arizona. Some of the seedlings planted in this valley bore fruit of excellent quality; accordingly it was Arizona rather than California that took the lead in scientific propagation of the date.

In 1889 the Department of Agriculture imported 59 offshoots in tubs from Egypt, nine from Algeria and six from Maskat, which were planted in the Arizona experiment garden at Phoenix. Those that survived flourished, but more were lost by various transplantings, and I believe there are now only two of this original importation in existence — one in Arizona and another, an Egyptian variety, near Indio.

In 1899 the coöperative date garden was established at Tempe, Arizona, by the State University and the Department of Agriculture and about 450 North African offshoots secured for it, a few being sent to other points in the southwest. Since then the Department of Agriculture has imported more than 1,000 offshoots from all parts of the world, until the Tempe garden has the largest collection of varieties to be found anywhere — something above 230.

Unfortunately, the soil of this station is utterly unsuited to careful investigations of the varieties, or even to the production of good dates, being heavily alkaline and saturated with drainage from irrigation ditches. The Department of Agriculture has established two stations in the Coachella Valley, one at Mecca on soil which is too sandy to produce the best results, and more recently a station near Indio, which is admirably located and will in time certainly become the principal station. At present it has not a large collection of varieties, but new

FIG. 266.—Rhars, an excellent date from Algeria, fruiting at the government experiment station, Mecca, California. (Original.)

ones are being added by bringing offshoots from the other stations as rapidly as possible.

The success of these government importations encouraged private growers, and several good plantations were started, notably those of the California Date Company at Heber, Imperial County, and Bernard G. Johnson at Mecca, Riverside County, California; the latter has since been sold to the American Date Company. Both these consisted principally of Deglet Noor palms from Algeria and are to-day the two oldest and finest private plantings in the country. Other importations followed, so that between 6,000 and 7,000 offshoots have been brought to the United States from Algeria, mostly of the Deglet Noor variety. Many of these have already yielded offshoots for planting, and as the government has been liberal in giving away or selling shoots from its palms, there are nearly 10,000 palm trees of foreign origin in the United States at the present time, the larger number being in the Coachella Valley.

Other growers, both in California and Arizona, have planted seedlings in large quantities, and some of these are already in bearing. The total acreage of dates in the southwest at present must be several hundred, of which at least 60 acres are now in bearing, many of them for the first time this year.

Evidently, this is an industry that has passed far beyond the experimental stage. The growers of Arizona, indeed, have been held back by lack of varieties suited to their peculiar climate, but this situation is now being remedied. The ranchers of Imperial Valley have been making so much money out of other crops that they have not given much time to dates; so the Coachella Valley is the principal exponent of the industry at the present time, and no one who has inspected what has been done there can entertain any doubt as to the future of date growing in the United States.

Climate.

The prime requisite for successful date culture is intense summer heat. Dr. W. T. Swingle of the Bureau of Plant Industry has carefully figured out the necessary amount (in Bulletin No. 53), but in practice it may be said that any of the localities mentioned at the beginning of this article: Coachella, Imperial, Palo Verde, Chuckwalla valleys and the lower parts of Arizona—meet the requirements for heat. The great drawback in many localities is that, while the midsummer heat may be intense, the autumn coolness begins too early, but this drawback is partly avoided by artificial ripening of the dates.

The palm will stand a good deal of cold weather in winter, if it is not too prolonged. Temperature of 17° F. in the Coachella Valley last winter injured the appearance of some of the palms, but apparently had no effect on the following crop.

Water.

The other essential, coördinate with heat, is water. There are few cultures that require as much irrigation as the palm, and one miner's inch per acre is a desirable supply for successful date growing, unless one is in a very heavy soil that will absorb and hold the moisture a long time. Warm water is an advantage: it is by the flow from hot springs that the dates of Hasa, most famous in the world, are produced. Artesian water in most parts of the southwest is sufficiently warm to be satisfactory.

Soils.

The question of soils is a little more complex. Normally the date succeeds best in a sandy loam; yet it is cultivated with good results in many places where the loam is in a very small amount. On the other hand, some of the best Deglet Noors in Algeria are grown in a stiff clay, comparable to that of Imperial Valley; while the excellent dates of the Tigris and Euphrates rivers flourish in a silt that is pure adobe, although the natives consider a slight admixture of sand preferable.

In general, the date can be grown in any good soil that is not too heavy, provided the right varieties be selected for the soil. A pure sand is to be avoided, however. The soil of the Mecca experiment station is one of the worst pieces in Coachella Valley, and it is only beginning to give fairly good results because five carloads of manure have been put in it during the last few years. Of course, the date will yield results proportionate to the good soil and good care it gets, just as other fruits will.

The palm is not at all discouraged by the presence of a slight amount of alkalinity in the soil. Some years ago it was held to succeed better in a salty ground than in a clean one, but many growers are beginning to doubt this and to hold that, while it is remarkably tolerant of alkali, it will give the best results in the best surroundings. However that may be, it is certain that a small amount of salt in the ground is no hindrance to successful culture, and that dates can even be grown after a fashion in soil that is too alkaline to produce anything else. The soil at Tempe, for instance, is so salty that weeds will not grow in the garden, and there is practically nothing, aside from the dates, except a few unhappy pomegranates. The salt on the surface is the thickest, and of course it does the least harm here, but the fact that the palms will grow at all in such surroundings speaks well for their resistance.

Any one who contemplates establishing dates in an alkaline soil should investigate it thoroughly to a depth of six or eight feet. If there is a good layer of soil which does not contain more than 1 per cent of salt, the date roots will spread out in this layer, and the palm will thrive even though there should be a surface layer, or several other layers, that are much more alkaline. If there is not a body of soil with less than 1 per cent of alkali, it is useless to plant dates and hope for good results. Those who intend to make commercial plantings cannot be too strongly advised to select land that is as rich and clean as possible, for their

results will be proportionately better. One often hears a rancher say, "I've got a piece of ground out there that isn't fit for anything else; guess I'll turn it into dates." Such practices are not likely to benefit either the land owner or the state very much.

If the soil is alkaline and the water supply pure, the latter will help overcome the former. On the other hand, if the ground is clean, alkali in the water will not do any harm. But salty soil and bitter water are a combination that should be avoided.

Offshoots and Seedlings.

Having picked out a piece of soil suitable for his purposes, the intending grower of dates is at once confronted with the question whether he shall plant offshoots or seeds. The former method is in use in all the important date-growing countries of the world; the latter has been advocated by government officials, particularly for growers without capital, and has enlisted some violently enthusiastic advocates, so that the date-growing world is now practically divided into two hostile camps.

A deliberate consideration of the experience of other countries, and of previous attempts in this one, as well as of the biological principles involved, should put each method in its proper place and remove the grounds for confusion. The seedling method may be summed up as follows:

Seedlings are planted thickly in nursery rows, and will often bloom in the third year, when approximately one half will be males, and as they do not bear fruit can be removed and destroyed. Within two years more the remaining females will have borne a little fruit, which can be tested, and those that seem desirable can be retained, while the others, perhaps three fourths of the whole, can be destroyed. The remaining females will probably be 20 per cent of the total number of seeds planted; these palms can be transplanted to orchard form. Obviously, some will be much better than others; as the plantation grows and all the palms produce offshoots, the inferior ones can be removed and replaced by offshoots from the superior ones. These offshoots will of course require five years more to come into bearing; so that it will be ten to fifteen years before the grower has a full acreage of bearing palms; but this will have cost him nothing except his time, other expenses of cultivation, and interest on investment.

The method has certain advantages for men — homesteaders, for instance — whose land is abundant and time very cheap. Most growers, however, if they calculate the value of their time and the use of their land for ten or twelve years will find that they would actually have saved money by planting imported offshoots in the first place. But worst of all, even when the orchard has been weeded out until only good palms are left, these will all differ, variation among seedlings being just as great in palms as in any other fruit.

On this last point there seems to exist considerable misapprehension. The fact that seedlings have sometimes yielded fruit fully as good as

and indistinguishable from the parent has been heralded so much that those not in touch with the situation come to think this is the rule rather than the exception. If one secures all the data in regard to any given planting, he will find the situation far otherwise.

Dr. Swingle, for instance, says in the bulletin above mentioned (page 201), "The seedlings of a single sort of date may present the most remarkable variations, and usually the parent type is not exactly reproduced by any of the offspring. This is clearly shown by the experiments of Colonel Sam Taylor, of Winters, California, who tried to propagate from seed the valuable, early-ripening Wolfskill date growing on his place. This was done because his palm had ceased to produce offshoots before its value was recognized. Many of these seedling dates

FIG. 267.—Thoory, a valuable dry or bread date from Northern Africa, fruiting at the government experiment station, Mecca, California. (Original.)

have fruited, but none resembles in the slightest degree the parent variety; most of them are much later and consequently fail to mature at Winters, where the summer heat is insufficient to ripen any but the earliest sorts."

Finally, any one who wishes to see how the seedling theory works in practice should visit the date groves of eastern Spain, which have been propagated by seedlings. It is true that the climate there is not favorable to the production of high-grade fruit; yet the influence of seedling propagation can be seen at a glance; every tree bearing a different variety, so that it is impossible to grade the dates, and they are sold very much as cull oranges are in California. Any one who tries to get into commercial date-growing by planting seedlings will secure similar results; even if his seedlings should be of good quality, they will be so

diversified that he cannot supply a high-priced trade, which demands well graded dates, each box uniform. Such dates at present can only be produced by planting offshoots, which will exactly reproduce the parent variety and allow one to know what he is getting.

On the other hand, it is to be desired that every grower should plant a few seedlings where they will not be in his way — as a windbreak, for instance — and let them grow. In this way the State will in time secure some varieties of local origin that may be as fine as anything known; and although propagation from one specimen will be very slow, yet it was in this way that all the famous foreign varieties were originally propagated. We are now taking advantage of the centuries of work of the Arabs; those who plant seedlings for commercial use are going several hundred years behind the times.

The Bureau of Plant Industry has set out nearly 400,000 seedlings in Arizona, with the desire to produce new varieties. Work has also been started to breed seedling dates, by securing males of known pedigree, Deglet Noor, for instance, and pollenizing Deglet Noor females with them. It will take several generations to get a male that is fairly pure, but when that has been done, seedlings can be produced with a much better chance of success.

Basing their decisions on the considerations above stated, nearly all growers with capital who have embarked in the date industry have done so with offshoots, and the number is increasing each year. At present any large number of offshoots can only be secured by importation from abroad, since the supply produced in the United States is only a small fraction of the demand. Excellent results have been had with importation, when proper care was used, so that it is not a risky proceeding. The California Date Company of Heber succeeded in getting 98 per cent of its imported offshoots to grow, whereas the best growers in Algeria, transporting their offshoots only a few miles, are satisfied with 75 per cent.

Needless to say, the female palm produces only female offshoots, and the male palm, males. Offshoots must be two or three years old when taken from the tree, and should be from 15 to 45 pounds in weight. After being left in the shade for a day or two to dry they are trimmed up, only a foot or two of the leaf stems being left, and the roots wrapped in moist moss or palm fibre. It is desirable to seal the cut ends of the stems with asphaltum, and if a long journey is contemplated, to coat the stump, where it was severed from the tree, with the same material. In transit, there is more danger in bringing the offshoots too wet than too dry — in fact, fair results have been had under favorable conditions with shipments in which no moisture is used. Bernard G. Johnson, of Mecca, has tried putting the palms in an iced car, at least for the latter part of the journey, and considers that this gives good results.

At present the county horticultural inspectors of California require that offshoots be kept in nursery rows for the first year, in order that scale may be eradicated. They should be planted to the depth of their

FIG. 268.—Khadrawi, a Persian Gulf palm fruiting at the ranch of Fred N. Johnson, Indio, California; seven years old and bearing one hundred pounds of delicious dates which began to ripen September 1st. This variety has proven to be especially desirable for Arizona also. (Original.)

greatest diameter, and it is well to shade them with palm leaves or a loose burlap wrapper, which will not only protect them from sun during the first summer but from frost during the following winter. They should not be planted until the ground is warm. May and June are the best months.

Bad luck has been had with offshoots brought from the Tempe garden and planted in Coachella Valley, where they show a disposition to sour and die. Taken from a sodden field, the dry soil and air of Coachella Valley are too much for them, and fermentation quickly sets in. It is worth while to notice this as a warning, that offshoots should not be transplanted into too dissimilar conditions. Such a situation rarely arises in practice, however.

Rooting the Offshoots.

When the offshoots are in the ground begins the most critical period of their life. Unless they are kept at the proper degree of moisture during their first summer, the loss will be heavy. It must be remembered that the process of rooting an offshoot is similar to that of rooting a slip or cutting in the open ground. Tiny rootlets are thrown out, and these must be nourished into vigor; a few days of drought in the hot desert sun may kill these soft roots, and the offshoot will then give up the struggle for existence. Some heavy losses have been recorded in the history of the industry in California, in most cases due to mere carelessness and negligence; but if unremitting care is used, there is no reason to apprehend any trouble in saving a very large percentage of the palms.

No hard and fast rule can be laid down for watering the offshoots, as it depends on the nature of the ground. Arabs in some parts of the Sahara, water them every day for the first forty days; in heavier soils, every day for the first week, then every other day for another week, and so on, tapering off. Sometimes a good plan is to water on two successive days and omit the third day, keeping this up for several months if the soil is sandy, but not putting too much water on at any one time. The soil must be kept moist, but it must also be allowed to dry out a little from time to time, in order to admit air, otherwise the offshoots will drown.

Half of the palms should show signs of growth before the first winter, and the rest will come along in the following spring and fall, it being not unusual for an offshoot to remain dormant for a year and a half after it is planted. When they are well rooted they may be transplanted to orchard form, preferably 33 feet apart each way or forty to the acre. From then on, they require little more than irrigation and cultivation with fertilizer once a year, and there is little danger of irrigating too much, if the soil is well drained. It is a waste of time to plant palms in a soil that is not well drained.

During most of the year they should be watered at least once a week, this being suspended while they are blossoming, and at the time the

fruit is ripening. During the summer, when the fruit is developing, twice a week would be good, or in light soil even oftener. In a sandy soil, Arabs sometimes give water every day; of course, good judgment must be used.

Pollinating the Female Blossoms.

The only operation which causes any trouble is pollination of the female blossom, which must be done by hand. A sprig of the male blossom is shaken over each cluster of flowers, and then tied in place there, so that Nature can complete the distribution of pollen. The females in America have shown a tendency to blossom early, often opening up in February, and it is not always easy to get male blossoms so early. The large number of seedlings recently planted will perhaps furnish more early-blooming males; in the mean time, those who purchase offshoots should see that they get three or four males to each 100, which are known to bloom at a suitable time. The California Date Company of Heber lost almost the whole of its first crop through inability to get pollen.

In Arabian countries, a little pollen is kept over from year to year for use on female palms which are precocious in blossoming. This is a desirable practice, as the pollen apparently loses none of its power; in fact, a pollenization was made this year at Mecca with pollen seven years old and gave good results. Experiments have also been made in pollinating date palms with the pollen of *Phœnix canariensis*, the common Canary Island date palm which is found in gardens all over California, and also with male blossoms of the desert fan palm, *Washingtonia filifera*. In both cases good results have been secured, and growers who find themselves unable to get pollen might have recourse to one of these expedients; but the danger of failing to get it becomes slighter each year.

After pollination water should be withheld for a few weeks in order to get the fruit well set; then the palm takes care of itself for some months. The first fruit will ripen about the beginning of August (this from early Persian gulf varieties) and the harvest will continue, as one variety after another comes into action, until well into October, when the Deglet Noor finally gets its berries filled with sugar.

Selling Offshoots.

In addition to the fruit a very profitable feature of the industry here will be the offshoots, which the palm produces until it reaches the age of fifteen years or more. It can not, of course, bear a heavy crop of fruit and carry a full load of offshoots at the same time, and as the offshoots are so valuable, growers now limit the tree to only a few bunches of fruit each year, letting it devote most of its energy to the reproduction of the offshoots.

In this way one might take off two offshoots each year, from the fifth to the fifteenth or longer, and at the same time get a profitable crop of

fruit. By the time the palm had ceased to produce offshoots it would be in the full vigor of maturity and could devote its energy to producing nothing but fruit. Those more interested in selling the fruit should remove the offshoots as fast as they appear, in order not to take the palm's vitality unnecessarily. As long as offshoots sell at $8 apiece, few will care to extirpate them in this way.

Experiments are now under way at the Indio Station with a view to making the palm produce offshoots more abundantly, and of finding methods to propagate the offshoots when they are very small — only a few pounds in weight. It will probably take a number of years to work out these problems, if indeed they are capable of solution.

Yield.

The yield of a palm in full bearing varies widely with the variety, but in no case should it be allowed to produce more than ten or twelve clusters, and for a younger palm four to eight is enough. If it is allowed to retain the full number of clusters it sends out, often fifteen or twenty, it will probably bear nothing the following year. Yields as high as 500 or 600 pounds for a single palm have been recorded, and it is not unusual to find a tree bearing half that much in California or Arizona; but in such cases it will bear less the next year, and if the grower gets 100 pounds to the tree, each year, he should be well satisfied; even this will only be with good varieties.

Artificial Ripening of the Fruit.

The softness of the date naturally makes it difficult to handle, and in some parts of Arizona, where late summer rains are frequent, these have proved a great obstacle to date culture because they fell on the fruit when it was ripening, and caused it to sour. A similar objection has always been found at the Tempe orchard, where the constantly wet ground caused the fruit to ferment easily; and it is for this reason that growers withhold irrigation after the dates begin to soften.

On the other hand, the dryness of the Coachella Valley atmosphere is such that the late Deglet Noor frequently begins to "mummify" just at the time it should be filling with syrup, and becomes a hard, dry, worthless berry. This might be eliminated by giving abundant irrigation at that period, so the fruit would fill with water.

However, these problems are all much more insignificant since the perfection of methods of artificial ripening, which are America's greatest contribution to the date industry so far; it is not too much to say that artificial maturation alone makes profitable date culture possible in the United States. It removes the element of uncertainty, the risk which growers of most fruits must face, and puts the industry in the class of dependable things.

Artificial ripening has been practiced in many other countries in different forms. The Spaniards dip their dates in vinegar, which acts

on them chemically; the Mexicans of Lower California lay them out in the sun during the day and roll them in blankets at night to steam. A somewhat similar process is applied to the famous Medjool date of Tafilalet, Morocco, according to Dr. Swingle. The first experiments on the subject in this country were made by the University of Arizona, which tried a wide range of chemicals, all of which converted more or less of the tannin, and Dr. Vinson finally settled on nitrous ether as the best agent; dates exposed to the fumes of this for a short time became

FIG. 269.—Neglet el Pasha, a twenty-one-year-old palm at Mecca, California. (Original.)

quite edible. R. H. Forbes, superintendent of the station, summed up the advantages as follows:

1. The fruit can be harvested cheaply, by the bunch, before the berries begin to drop or are attacked by insects, moulds or bacteria.
2. Danger of loss by untimely rains is minimized.
3. The ravages of worms in the ripened crop are avoided.
4. Greater cleanliness of the product is possible than with naturally ripened dates.
5. Late varieties, among them the Deglet Noor, which do not ripen satisfactorily here, may be successfully brought through.

6. Early varieties may probably be grown and ripened at higher altitudes than formerly.
7. Dates while yet hard may be shipped without injury to a distance, then ripened artificially, and marketed in a fresh and prime condition.

Previous to his chemical experiments, Dr. Vinson had tried moist heat, which he had later abandoned. Mr. Freeman of the same staff took up this feature, and carried the experiments along until he had secured good results, the only drawback being that much of the cane sugar was turned into invert sugar by the process.

At this point Mr. Chumard, manager of the California Date Company at Heber, began to experiment, and made certain changes in the technique which allowed him to market one year's crop in good condition. Where he left off the Bureau of Plant Industry began work, and Prof. S. C. Mason and Bruce Drummond at the Indio Station have perfected the method to a point where it seems to be entirely satisfactory. They have succeeded in avoiding the inversion of most of the cane sugar, and also cut down the length of time necessary for exposure in the oven.

In their work they have used a large poultry incubator, since no great degree of heat is required. The fruit is picked when it is just beginning to color, but is still hard, and I understand that it is soaked in water for from twenty-four to forty-eight hours; then put in the incubator on a screen with a pan of water underneath, and kept there from eighteen to twenty-four hours at a temperature ranging around 110° F. As they have not yet published the results of their investigations officially, the exact results are still withheld from the public.

Success depends on absolute control of the moisture and heat, so the process is one that will always call for some judgment, just as baking bread does. It is not complicated, however, nor is it expensive, and it effects such a marvelous change that I believe all fruit marketed in the future will be processed in this way. It also saves a week or ten days in putting the fruit on the market, since it would require that much longer to mature on the tree. The exact technique for each variety of dates will have to be worked out, and each grower who ripens his own will have to experiment for himself until he learns the operation. Probably galvanized iron or zinc ovens will be constructed, with moisture pans at the bottom, and heat supplied by a lamp just as it is for the incubation of eggs.

The University of Arizona experiment station has published the results of its work on the crop of last year, which was a particularly unfavorable one, and reports: "The results of the season's work have shown that evenness of maturity is one of the most important factors in successful date culture in most parts of Southern Arizona. Varieties that mature evenly can be artificially ripened without loss into high quality fruit in the most adverse seasons; while varieties that mature less evenly, such as the Rhars, will yield at any given time only about 75 per cent or 80 per cent of marketable fruit, of which a large part is

relatively worthless, due to its lack of sugar and flavor." Evidently, the question of varieties is all-important, even with artificial ripening; without this, date culture would be almost hopeless as a commercial prospect in the adverse conditions of the Salt River Valley. But by selecting the proper varieties, the report declares that even under the most adverse conditions, "from 95 per cent to 100 per cent ripened into first quality fruit of their class" by artificial means.

It was Deglet Noor fruit, grown by Fred N. Johnson of Indio and ripened artificially at the government experiment station, which sold for $1.00 a pound in Los Angeles last fall. Furthermore, it has been found possible to take Deglet Noor berries which had "mummified" on the tree and, by putting them through the incubator, to restore them to perfect condition. And the process will be even more valuable for the softer varieties of dates than it is for Deglet Noor, since they are more liable to injury if left to ripen on the tree. The amount of fruit wasted by the Arabs in handling is appalling, and in Arizona, in bad seasons, the crop has been almost a total loss; these calamities will be averted by artificial ripening, and the certain profits of the industry increased to that extent.

Packing for Market.

There is no doubt but that the best quality of dates should be put up in fancy one- or two-pound boxes for the American retail trade, just as confectionery is put up. In this way alone can fancy prices be realized. But the great bulk of the trade will still remain in the second grade berries, selling in bulk at 15 to 25 cents a pound, and so far superior to imported dates in handling and cleanliness that they will hardly be competitors.

The Control of the Date Palm Scales.

The perfection of a method of artificial ripening removed one of the two great obstacles to the success of date culture in the United States; the other was swept aside this spring, in the discovery of means to exterminate the scale insects which, introduced from North Africa on offshoots, had threatened the life of the industry in this country. By the use of a mealy-bug spray based on various phenols, principally cresylic acid, the problem has been solved and no longer need worry the grower or intending grower.

The Parlatoria scale (*Paralatoria blanchardi*) was introduced into the United States on the first importation of offshoots, made in 1889. It is a gray or brownish insect living on the leaves of the palm, and apparently confined to that plant alone; it remains nearly dormant during the winter, but is active throughout the summer. It proved very difficult to reach with insecticides, but finally the method of burning over the palms with a gasoline torch was originated, and many of the older orchards in the southwest were so treated last year. This set them back for a year, but did not injure them permanently, as the palm is extraordinarily resistent to fire.

The Marlatt scale (*Phœnicococcus marlatti*) was possibly introduced at the same time, or at any rate on the following importation of offshoots from Africa. It lives usually at the base of the leaves, inside the palm where it is almost inaccessible, but comes out at intervals during the winter to moult. The female secretes a white, waxy substance, but not a true scale like Parlatoria; its life cycle is about forty days. When a palm is pulled apart masses of the scale may be seen at the base of each leaf, sometimes so thick as to look like a piece of beefsteak. This scale caused particular damage by clustering around the young spadix before it had emerged from its sheath, and sucking the sap out of it, so the cluster appeared withered and the dates which it set were shriveled and unfit for use.

FIG. 270.—Khadrawi palm imported from the Persian Gulf, seven years old, Coachella Valley, California. (Original.)

No natural enemy of the Marlatt scale is yet known, although ladybirds and other insects prey upon the more exposed Parlatoria. Experiments made in the Coachella Valley this spring showed that both scales yielded to the phenol dip, and all offshoots are now immersed in this for two fifteen-minute periods, before planting. No ill results are visible, and the treatment practically exterminates the scale. In some cases where the *Phœnicococcus* was in dense masses, a few in the under layer survive, but these can easily be reached by a spray the following spring. It is, then, proper to say that we are now sure of being able to keep these two dangerous scales in absolute control, and when further study of their life history teaches us more effective methods of combating them, there is every reason to suppose that they can be absolutely exterminated.

North African Types and Varieties.

The subject of varieties is just as important with the date as with any other fruit and it is fortunate that the southwestern states now contain the largest collection of varieties to be found anywhere in the world, so that we are gradually getting full data as to what should be planted here. As was to be expected, some varieties have not succeeded so well here as in their native home; some have succeeded better: but there are a dozen or more which can be confidently recommended for planting, and on which the planter runs no risk of making a mistake.

Dates are ordinarily divided into three types: soft, semi-dry and dry. The finest varieties fall under the first class, the second contains a number of good ones for every day use, while the third type is unknown to Americans, although it is the one preferred by most Arabs for a steady diet, since it is not so cloying or heating as the softer kinds. In North Africa the mountain and oasis dwellers usually eat dry dates, while the nomadic caravan Arabs prefer a very soft date (usually the Rhars) packed tightly into skins in a sort of paste. The dry date is usually light in color and the flesh sometimes so hard that it is eaten with difficulty; it has a pleasant nutty flavor, reminding one more of a cereal than a date, and the fruit has the great advantage that it can be kept indefinitely under any kind of conditions without deteriorating in any way. It can be handled as readily as peanuts for shipping or packing. Few have yet been planted on a commercial scale in the United States, but it is to be desired that some one start a plantation of these in order to test the market; there seems little reason to doubt that a good trade would be quickly developed, especially among the rapidly growing class of people who use fruit and nuts largely as diet.

Among the varieties that have been introduced to California or Arizona and fruited here, the following are best known.

Deglet Noor must be put first, because it is the most widely cultivated, if for no other reason. It is the standard of excellence in North Africa, where it is the only date served on the table of the rich, as a general rule; and while it is perhaps not the finest date grown there, yet it is by all odds the best that is widely obtainable. Thomas H. Kearney describes the variety as follows: "A soft date, one and one third to a little over two inches long and about one half as wide, ovate oblong in shape, generally widest at or near the middle and blunt pointed at the apex, often narrowed also at the base, maroon colored when ripe, the flesh two to three lines thick, translucent, the seed a little more than one half as long as the fruit, conspicuously pointed and dark chestnut in color. The stalks and branches of the fruit clusters are bright yellow (not orange), the stalks long and slender, sharply curbed near the base, so that the branches hang down far below the crown of foliage. The trunk is comparatively slender. The foliage is light and delicate looking, and the narrow leaves and leaflets are rather yellowish green. The spines are slender and weak."

This variety has many advantages. Its offshoots are more easily transplanted than those of any other; it bears quite heavily in this country (although considered a shy bearer in Algeria); and it bears evenly every year, if well treated. Its root system is rather shallow, however. It matures as late as any, usually in October. In flavor it is particularly mild, having very little of what may be called the characteristic date taste, and in fact more resembling confectionery than dates. No doubt it will continue to be sold on this basis for many years to come.

Menakher, the famous date of Tunisia, has gained a good deal of notoriety through its romantic history, but its performance in the United States has been something of a disappointment. The fruit is improving, however, as the trees grow older. It is one of the largest dates grown, and the story is that it was considered the finest in Tunisia, under the despotic régimé of the Beys, so these rulers used to order the whole crop from every one who grew Menakhers, and then forget to pay. After this had gone on a great many years, the growers decided they would rather raise some inferior date from which they could derive a little income, so cut down their Menakher trees, and the variety is practically extinct. The Bureau of Plant Industry has two trees in this country, however, and their offshoots will slowly establish the date here. Its size, added to its good quality, is certain to make it valuable.

Rhars, the commonest Algerian variety, has been planted to a considerable extent in the United States, and the fruit as handled by American methods is certainly much preferable to the disgusting mess sold in the Algerian markets. Its principal value is earliness, but as the better Persian Gulf dates come into the market, it will lose this advantage, and I believe it will lose its popularity. It has proved a shy bearer in this country, and unless very carefully handled is a difficult shipper. The offshoots are hardy and resistant; the roots go deep down for water, and the tree requires less fertilization and irrigation than choice varieties like the Deglet Noor. In Algeria it tends to bear only every other year. The Arabs consider it the best date grown from the point of view of healthfulness, and eat it in immense quantities without detriment to their digestive organs; they even make it into a paste with grease and give it to colicky infants. They also declare that if buried in the ground it can be taken out again after six months, in perfect condition.

Dr. Swingle has been advocating the growth of Rhars in the more favored parts of the San Joaquin Valley, believing that experiment would show that good dates for local use could be produced there. So far as I know, the experiment has not yet been made. I believe the best Rhars grown in California have been on the sandy soil of the Mecca ranch planted by B. G. Johnson. In the wet soil of the Tempe garden it has proved a great failure, the last report of the station noting "unevenness of maturity to be as serious a commercial defect in the Rhars dates under the conditions prevailing in Salt River Valley the past season as the poor keeping quality of the fruit when ripe."

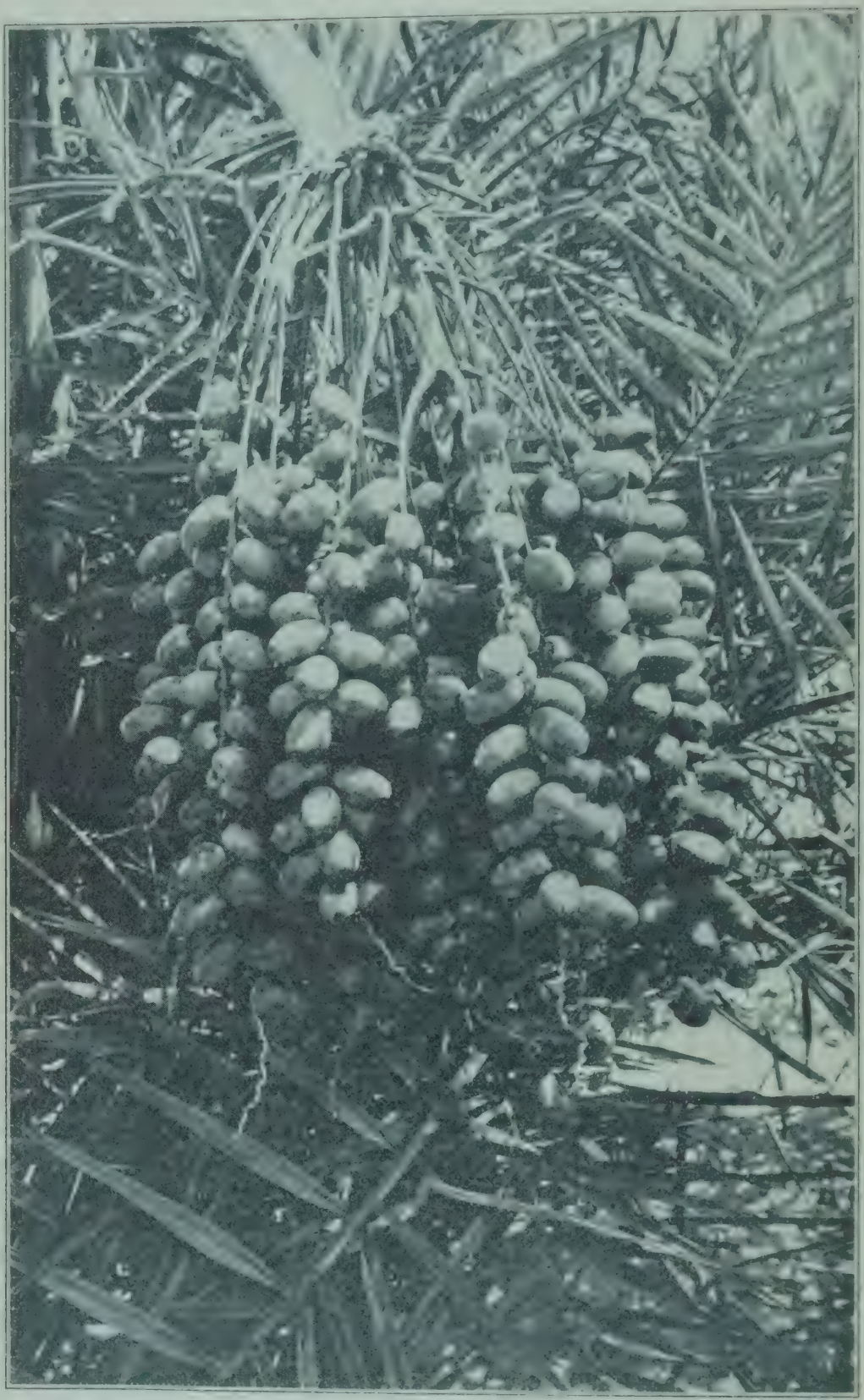

FIG. 271.—El Kseba, an early ripening variety from Tunis, fruiting in the Coachella Valley, California. (Original.)

Itima is one of the choicest Algerian varieties, ranked equal to Deglet Noor by some natives, and certainly deserves to be placed second to it. The berry is large, soft and the color of café au lait; the offshoot is delicate.

Thoory is considered by government experts to be the best dry date so far tried out in the United States. It is a rare variety in the oases of the Western Zab, Algeria, but eight fine trees are now growing at the Indio station, from which the variety can be perpetuated.

Horra, a large, light yellow, dry date common in Algeria, has been introduced in more quantity, and can be recommended.

Tadala and **Bent Kebala** are varieties originating in the M'zab oases of Algeria, which are promising for this country, although not yet planted on a commercial scale.

Many other Algerian varieties have been introduced, but most of them are still confined to the government experiment stations. Commercial importers during the last few years have practically limited themselves to the Deglet Noor, and the field for this is temporarily exhausted. Competition of American offshoot buyers has also resulted in doubling the price for this variety during the past few years, so the Algerian growers have become discontented, and it is likely that further exportation of offshoots from that colony will be forbidden. This will cause commercial growers in the United States to turn to the famous dates of the Persian gulf, which have been undeservedly neglected, solely because Algeria was so much more accessible.

Persian Gulf Varieties.

Ten years ago David G. Fairchild of the Bureau of Plant Industry made a visit to the Persian Gulf region, hastily studied the principal varieties, and brought out offshoots of most of the good ones. Some of these did not survive, and although other offshoots have been obtained from time to time by correspondence, no student of date culture has been in the district since his trip. Furthermore, the labels on many of the Persian Gulf dates brought to this country were lost, so that of those now at the Mecca station, for instance, almost none can be definitely named.

It will thus be understood that these dates have been tried out under the most unfavorable circumstances. Nevertheless, by their quality and still more by their early maturity, they are rapidly winning a place for themselves, particularly in the hearts of Arizona growers, whose climate has led them to search for new varieties while Californians were confining their attention to the Deglet Noor. Of the Persian Gulf dates which have fruited in this country, the following are of high merit:

Kustawi. "A medium to large, oblong, soft, sticky date, ripening in August, with stone of small size and little or no fibre or 'rag.' Skin a light golden brown, very delicate in texture and adhering to the soft golden flesh, which is of exquisitely rich, sweet date flavor." (Fairchild)

Maktum, considered one of the two best sorts in the Baghdad region, closely resembling the Kustawi but of finer quality.

Halawi. This is the date principally sold on the American market in very bad condition, under the trade name of "Golden Date." It is the commonest variety around Basra, but as grown under American conditions it is a fruit superior by far to anything Americans have previously eaten under that name. It prefers an adobe or clay soil. So far as I know, the only imported Halawis have fruited in Arizona, but Fred N. Johnson of Indio has a seedling Halawi which happens to reproduce fairly well the characteristics of the parent, and is highly

FIG. 272.—El Kseba, imported from Tunis, fruiting at the government experiment station, Mecca, California, September 5, 1912. (Original.)

esteemed. The Halawi ripens a little later than the first two mentioned, and is described by Fairchild as "a medium-sized, soft date of sticky consistency. The stone is medium to small; there is little fibre present, and the light brown skin of delicate texture sticks closely to the flesh, which is abundant, of a deep brown color, golden toward the stone. It possesses a strong date flavor and is of unusual sweetness. It is one of the best packing dates, as it keeps well and can be sent all over the world."

Khadrawi is one of the best tried out in this country, and is similar in general characteristics to the Halawi. It is highly prized in Arizona: Fred N. Johnson of Indio has an imported palm which is believed to

be this variety, and which produces dates of excellent quality, although they demand different methods of handling than the Deglet Noor.

Fard, the famous date of Maskat and the best exported to America, has fruited in the United States only as a seedling. It is believed, however, that this date does even better in this country than in its own home, and as it is a variety of particular excellence for packing and shipping, it is one to be marked as desirable. Sandy soils would probably suit it best, although the great Semail Valley of Oman, where it grows, has never been entered by a man scientifically interested in the study of dates.

Moltagi is a little known Persian Gulf date enumerated by director R. H. Forbes as one that has done well under conditions at Tempe.

Early Varieties.

It may well be doubted, however, whether we have yet secured the varieties that will eventually prove most desirable. The Deglet Noor itself may be relegated to the lower ranks, as new countries are laid under contribution by the growers of the United States, and it is certain that the early ripening Persian Gulf dates will do much to minimize the importance of the Deglet Noor and other late varieties, since the former will be on the market and all sold weeks before the latter are obtainable. The wise grower will, of course, plant both early and late varieties, thus extending his season from August 1st to November 1st; he certainly will not confine himself solely to late varieties, as he has done in the past. On this point the twenty-second annual report of the Arizona Agricultural Experiment Station says:

> The study of varieties has been found most gratifying in that several have been found that will furnish a substantial basis for future successful date culture in Arizona. These varieties respond easily and perfectly to artificial methods of ripening and furthermore mature evenly enough under the most adverse Salt River Valley conditions so that they may be harvested by the bunch, and from 95 per cent to 100 per cent ripened into first quality fruit of their class. In quality none of them approaches the Deglet Noor, but it is believed they will not enter into competition with that fruit since they will have been harvested and consumed weeks before the Deglet Noor crop matures. Moreover, they will find an entirely different market, since they can be produced at a price that will make them food for every one, rather than a delicacy for the wealthy.
>
> Among the lighter colored or so-called "golden" dates that meet these conditions very perfectly, have been found the Khadrawi, the Kustawi, the Maktum and the Moltagi. The Khadrawi, in particular, is a most excellent variety, and handles well in the orchard; the Kustawi is a close second, although somewhat inferior in size. Several large varieties of dark colored dates have also proved very satisfactory under the unfavorable climatic conditions of the past year. These were the Nazl el Bacha, the Birket el Haggi and the Hayani. Although rather coarse in texture, their great size and general appearance secure a ready market for them. There seems to be no reasonable doubt that the culture of any of these varieties will prove commercially successful under the conditions prevailing in the more favorable localities for date growing in southern Arizona.

These choice, early Persian Gulf dates are to be imported on a large scale next spring, and with them it is hoped to bring a large number of offshoots of the most famous date in the world, the Khalasa of Hasa. This superlative variety was secured by Mr. Fairchild, but did not

survive. The district around Hofhoof, where it grows, contains 2,000,000 palms, according to the Turkish census of 1871, and there seems to be no reason why this should not be secured on a large scale. If it can be established in California in that way, it is likely at once to assume the place of chief dessert date, supplying the fancy box-trade that has already proved so profitable.

Khalasa. The explorer W. G. Palgrave says, in his "Narrative of a Year's Journey in Central and Eastern Arabia," written in 1863:

Almost the whole space between Hofhoof and Mebarraz, a distance of about three miles, is filled up with gardens, plantations and rushing streams of water. Here and for many leagues around grow the dates entitled "Khalas"—a word of which the literal and not inappropriate English translation is "quintessence," a species peculiar to Hasa and *facile princeps* of its kind. The fruit itself is rather smaller than the Kaseem date, of a rich amber color, verging on ruddiness, and semitransparent. It would be absurd to attempt by description to give any idea of its taste; but I beg my Indian readers at least to believe that a "Massigaum" mango is not more superior to a "Junglee" than is the Khalas fruit to that current in Syrian and Egyptian marts. In a word, it is the perfection of the date. The tree that bears it may by a moderately practiced eye be recognized by its stem, slenderer than that of the ordinary palm, its less tufted foliage, and its smoother bark. Another species, also limited to this province, is the Rekab: it would hold the first rank anywhere else. During my stay in Arabia I counted a dozen different kinds of date, each perfectly distinct from the other; and I have no doubt that a longer acquaintance might have enabled me to reckon a dozen more. As to the Khalas in particular, its cultivation is an important item among the rural occupations of Hasa, its harvest an abundant source of wealth, and its exportation, which reaches from Mosoul on the northwest to Bombay on the southeast, nay, I believe, to the African coast of Zanjibar, forms a large branch of the local commerce.

Mr. Fairchild describes it as follows, in his bulletin on Persian Gulf dates:

Khalasa (or Khalasi). A medium-sized, ovate, sticky date with small stone and no fiber, ripening as early as August in the region of Hasa. The skin is a golden brown and of most delicate texture, covering closely the rich, golden flesh, which is of exquisite date flavor and with the consistency of a chocolate caramel. Said to be a delicate packer and never exported except in the form of presents. It has the renown all over the Persian gulf of being the most delicious date in the world. Of its productiveness or hardiness little known, but it is probably that a sandy soil will suit it better than an adobe soil, as it comes from the sandy region of Hasa, which is fed by underground water courses. This variety probably requires surface irrigation also.

Medjoul. With this must be mentioned the Tafilalet date known as "Medjoul," certainly one of the best dates grown. The oases of Tafilalet are in the Saharan part of Morocco, where they can at present hardly be reached by a foreigner, and but little is known of the date except that it is largely exported to England and Spain by the Moors. Many seeds have been planted in the United States during the past year since Dr. Swingle heralded it as one of the coming leaders in date culture; and a Coachella Valley company claims to have secured a few offshoots of it from the oasis of Colomb-Bechar, in Algeria, last winter. Dr. Swingle is attempting this winter to secure authentic offshoots from Morocco, and to secure more data relative to the method of artificial maturation practiced, which gives the flesh the consistency of a chocolate caramel, and renders it so dry that it can be shipped anywhere.

The date is larger than most of those so far introduced to the United States, dark in color and characterized by a wrinkled skin. Unfortunately, there is little prospect of getting offshoots on a commercial scale for several years, because of the unsettled state of political affairs in Morocco, and even then the government may decide to prohibit the exportation.

There are a dozen or more other varieties of superlative dates in the world, which have not yet been secured for the United States, and any one of these may turn out to be equal to our best. The industry will not wait for them, however, although the Bureau of Plant Industry is showing commendable zeal in securing them; but with the Persian Gulf dates to be secured this winter, and the North African varieties already here, there is range enough to suit the most fastidious grower.

FIG. 273.—Seven-year-old palm fruiting at Indio, California. Sacking the valuable clusters is the best method of protection from insects and birds. (Original.)

Buying Genuine Varieties.

The question is often asked, "How can one be sure, in buying offshoots, that they will be true to name — that he will not be deceived by the seller?" If he is buying only one or two offshoots, he must depend on the honesty of the seller, unless he is as expert as the Arabs, who can tell most of the varieties merely by a glance, under any conditions.

In buying offshoots on a large scale, for importation, the problem does not present itself to any marked degree. Each variety is charac-

terized by certain differences in color, in foliage, in the arrangement of the spines, and particularly in the arrangement of the fibre, which are present just as much in the offshoot as in the parent tree, and serve as reliable and invariable guides to the identity. Consequently, if one is buying a large number of any variety, and an odd one is put in the pile, it sticks out like a sore thumb in the midst of so much uniformity—even the novice could detect it. The only way in which one could be deceived would be that the whole lot he bought was of one variety, but not the one he wanted; and this is unthinkable since, even if most of the many sellers with whom he must deal were scoundrels and anxious to cheat, there would always be a few honest ones; and if one man out of twenty sold what he had promised, the difference in the appearance of his offshoots would at once lead to an inquiry that would result in exposing the whole deal.

In practice, the American buyer always employs an experienced Arab, a man of standing in the community, who has a reputation to sustain and who can be thoroughly trusted. This man can tell by a glance at each offshoot whether it is true to name or not, and when the whole shipment is brought together, a far less practiced eye can check up the list. So there is practically no chance for mistake when offshoots are bought in this manner.

During the first importations of offshoots, when they were sent in by natives without any supervision to persons who had in some cases never seen an offshoot before, there was occasional deception. The shipment of 1889 proved to contain a number of males, labeled as females, of choice Egyptian varieties; and even as late as the government importation of 1904–5, which brought the Menakher to this country, several of the offshoots furnished under that name were males. Growers have now had enough experience to recognize the male offshoot without error; but even without this slight experience, if those first importations had been supervised as all commercial importations now are, there would have been no room for fraud. In the Menakher case, offshoots were altogether refused for a long time, but finally Mr. Kearney's importunities prevailed and he was furnished a few. Some one may have thought to curry favor by seemingly increasing the number through the addition of a miscellaneous lot of offshoots under the name of Menakher: but such a mistake could not happen now.

Profits of Date Growing.

Finally, a few words on that delicate and interesting question, the profits of the date industry.

Although there will always be a high-priced trade in fancy box dates, such as the Deglet Noor or Khalasa, not much of the total output can be expected to sell for any length of time at $1.00 a pound, as it did in Los Angeles last fall. It is reasonable to suppose, however, that for this confectionery trade prices will not fall below 50 cents a pound for some years. Then there will be the larger trade in strictly first-class

dates, preferably in small boxes, but possibly in bulk, at all seasons of the year; the most profitable part of this will be the early sales of Persian Gulf dates during the months of August and September. These clean and attractive home-grown dates ought not to bring less than 20 to 30 cents a pound, for many years to come. Finally there will be the inferior dates, the imperfect ones and the poorer varieties, sold in bulk as the imported dates are now dispensed, but cleaner and more attractive; these can profitably be sold at prices that will meet the competition of the imported dates, or cut below them — 10 or 15 cents a pound. It will be many years before the production in the United States can become sufficiently large to lower these prices.

Furthermore, the consumption is certain to increase as the production increases. At present the United States consumes a ridiculously small amount — only 22,000,000 pounds a year, or something like a pound per family per year, whereas in Arabic countries a family often consumes 10 or 15 pounds per day. Many residents of the United States have never tasted clean, fresh dates, and when they find they can buy them at reasonable prices, the demand is certain to jump. The present consumption could be multiplied by 10, 20 or 30 and still be small compared with that of fruits that are less nutritious.

If one allows 75 pounds per tree, which is below the mark, and 40 trees to the acre, he can cut off as much of the proceeds for the middleman and retailer as he likes, and still have a profit that will suit the most fastidious. Let him add to this the profit on 400 or 500 offshoots per acre, at even $4.00 apiece — half the present price — and he will make the proposition still more attractive. Best of all, the element of uncertainty and risk has almost been removed through the perfection of the methods of artificial ripening. As the date will keep indefinitely, and does not require to be marketed on the spot like oranges and most other fruits, the grower can always avoid a glutted market, if there should ever be one, and hold his fruit for better prices, just as wheat growers do.

The situation looks rosy, and is looking rosier each year, as new plantations come into bearing and again demonstrate the possibilities. I do not see how a careful, intelligent rancher with a plantation of choice imported varieties, who gives the matter his personal attention, can make less than $500 per acre; and I believe those who enter the industry now, getting advantage of the high prices for fruit and offshoots during the first few years, will not fail to clean up several times that sum annually.

GENERAL NOTES.

QUARANTINE ORDER, NO. 15.

August 30, 1912.

WHEREAS a quarantine order, No. 1, issued March 6, 1906, was declared against the citrus white fly (*Aleyrodes citri*) from the States of Florida and Louisiana, and only from these states; and

WHEREAS we have information from the entomologists of the United States Agricultural Experiment Stations of the South Atlantic and Gulf States that this same white fly (*Aleyrodes citri*) is widely distributed in North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas; and

WHEREAS it has been received into California on nursery stock from North Carolina and Mississippi; and

WHEREAS another species of the white fly (*Aleyrodes nubifera*) is present in Florida; and

WHEREAS both of these white flies are serious pests, being regarded in Florida as second to none in their injurious work on citrus and other trees; and

WHEREAS there is great danger of introducing *Aleyrodes citri* into the citrus groves of California on plants or nursery stock from each of the states aforesaid at the present time; and

WHEREAS there is danger of said *Aleyrodes nubifera* being introduced into California from Florida, and into the South Atlantic and Gulf States from Florida, and from thence into California; therefore, it is

Declared, That a horticultural quarantine be and is hereby established against all fruits and vegetables (excepting tomatoes), nursery stock, scions, grafts, buds, cuttings, fruit pits, orange seeds, trees, vines, plants and shrubs of all kinds imported from the States of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas, or any other section known to harbor either *Aleyrodes citri* or *Aleyrodes nubifera*, or both, into the State of California; all quarantine guardians and deputies of the State Horticultural Commissioner are hereby instructed and required to hold any and all such fruits and vegetables (excepting tomatoes), nursery stock, scions, grafts, buds, fruit pits, orange seeds, and plants of all kinds, subject to the order of the shippers or owners thereof, for exportation out of the State, or to be destroyed;

Provided, That orange seed and fruit pits may be received into the State of California upon compliance with the following conditions: Every lot of orange seed or fruit pits brought into the State of California from North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas, or other territory infested with either *Aleyrodes citri* or *Aleyrodes nubifera*, or both, must be enclosed in a box sufficiently tight and secure to prevent the egress of these pests, should any be enclosed; every lot of such orange seed or fruit pits must be shipped to the Deputy Quarantine Officer of the California State Commissioner of Horticulture, in Los Angeles, or to any other person authorized in writing by the State Commissioner of Horticulture to receive it; every lot must be delivered at such freight or express office as shall be designated by said Deputy Quarantine Officer, or any other authorized person, and held by him in quarantine, and sufficiently treated until in his judgment the lot shall be released. All expense incurred in treating for disinfections of such lot of orange seed or fruit pits shall be paid by the consignee or owner, and the orange seed or fruit pits shall not be released until the same is paid.

A. J. COOK,
State Commissioner of Horticulture.

Approved by:
A. J. WALLACE,
Acting Governor of the State of California.

INSECT PESTS OF FARM, GARDEN AND ORCHARD.

In a volume bearing this title, Prof. E. D. Sanderson, Dean of the College of Agriculture, West Virginia University, has produced a valuable work of reference for the farmer, fruit grower, and practical entomologist. The book is largely a compilation from government and experiment station bulletins, and from the writings of economic entomologists in various publications, and is divided into chapters, each of which treats of the insects affecting a certain group of plants, such as small grains, beans and peas, grapes, apples, pears, etc. Citrus fruit insects are not included.

The insects discussed are chiefly those of the eastern states, but so many of them occur in California that the book will be found very useful to the farmers and growers here. Such insects as the codling moth, peach moth, phylloxera, woolly aphis, pear-leaf blister-mite, black peach aphis, and San José scale are given admirable treatment. The book contains very nearly seven hundred pages, and has over five hundred excellent illustrations. It is published by John Wiley & Sons, New York, and is priced at $3.00 net. E. J. NEWCOMER.

HORTICULTURAL CONDITIONS IN HUMBOLDT COUNTY.

The writer has just returned from a somewhat extended trip throughout Humboldt County. Last winter the growers made special request that a member of the State Commission make a trip into Humboldt County for two purposes, viz: To arouse interest in the appointment of a county horticultural commissioner under the present law; and, second, to suggest methods of controlling the woolly aphis and the green apple aphis, which were almost entirely destroying certain orchards throughout the county. The trip was made with the results that not only was a new county commissioner appointed but the growers began active work spraying for the apple aphids. The last trip showed that the work was not without good results. Nearly all of the badly infested orchards were sprayed. Some several times. The results in many of them are very marked and good crops of fruit produced where none was marketed last year. In some cases, however, good results were not obtained, though conditions are much better than they previously were. We contribute the poor results to the following causes:

First—The lack of good spraying equipment. All of the orchards were sprayed with hand sprayers and it was found that the tops of the larger trees were not properly and adequately sprayed.

Second—The work of applying the spray was not thoroughly done. Though liberal applications were made they were not done by men experienced in this line of work.

Third—Many of the orchards are not properly cared for. The trees are thickly brushy, being poorly pruned, and the majority of the orchards are seeded to alfalfa, in many of which this condition has existed for six or seven years.

At the present time there is practically no codling moth in most of the orchard-growing sections, while San José scale is scarcely noticeable. The Tussock moth has caused no trouble. In fact it has never been reported from the county. Though the California tent caterpillar is somewhat evident in the county, it does little or no damage. Apple scab is the most serious pest, and so far it has received practically no treatment whatever.

One thing is very noticeable, and that is, the growers and the new county commissioner, Mr. Weatherby, are thoroughly alive to the situation, and are doing all in their power to make conditions better. There is certainly a rich field in Humboldt County for fine orchards, and we have every reason to believe that in a few years conditions will be better there than in most orchard counties. E. O. Essig.

GET READY TO SPRAY FOR PEACH BLIGHT.

The latter part of October or the first part of November is the time to do the first spraying for peach blight. The fungus causing peach blight begins its work in the fall and must be sprayed for at that time. The California Experiment Station in Bulletin 191 recommends spraying thoroughly with Bordeaux mixture between October 25th and November 15th, using 30 pounds bluestone, 35 pounds lime to 200 gallons of water.

In February another spraying with Bordeaux mixture, 20–20–200, or with lime-sulphur solution, should be done. Many growers have come to prefer the lime-sulphur for the second spraying. This treatment will also tend to prevent the attack of the fungus causing peach leaf curl. H. S. Fawcett.

NOTES FROM THE COUNTY COMMISSIONERS.

By G. E. Merrill.

Madera County. Commissioner Marchbank is a nominee for the assembly and was a visitor at this office while in Sacramento as a delegate to his party convention.

Sacramento County. Many minor outbreaks of the red-humped caterpillar (*Schizura concinna*) have been reported to Commissioner Bloomer, the State Insectary and the Main Office. Mr. Bloomer reports extensive outbreaks of crown gall on hops in some districts; he also reports good success in the Johnson grass fight.

San Joaquin County. Outbreaks of the fall webworm (*Hyphantria textor*) on willows are reported by Commissioner Garden.

Santa Cruz County. Commissioner Volck has been engaged during the past month in making records of results of extensive spraying experiments carried on by his office in coöperation with the United States Department of Agriculture. Many new formulas have been tried and much interest is felt in the results, some of which will be discussed in the government bulletin soon to be issued.

Mr. Volck announces the appointment of two new inspectors, F. W. Hitchings and J. H. Pilkington, both of Santa Cruz.

Shasta County. A 250-mile drive to some of the more remote fruit sections of this county was an incident in the year's work of Commissioner Lamiman.

Stanislaus County. Much less damage was done by the Russian thistle this year than last, according to the report of Commissioner Rutherford. He reports further that many Russian thistle infestations have been eradicated in his county and that the Johnson grass is under good control in the uplands.

Sutter County. Extensive outbreaks of *Heliothrips fasciatus* on beans have claimed the attention of Commissioner Stabler. The pest has been effectively controlled by means of a flour paste spray made according to a formula recommended by Mr. W. B. Parker of the Bureau of Entomology. Mr. Stabler also reports that the fall webworm (*Hyphantria textor*) is attacking the peach trees in his county.

EDITORIALS.

FEDERAL QUARANTINE.

All California growers are undoubtedly aware of the fact that on the 1st of October the Federal Government began the maintenance of a quarantine on the Pacific Coast. Mr. H. A. Weinland has returned to California, Dr. E. A. Back having assumed complete charge of the work in the territory of Hawaii. So far as California is concerned nothing has yet been done by the Federal authorities in the inspection work, and the State force continues as it has always done in the past. Until now this force has been able to prevent the introduction of both the melon maggot and Mediterranean fruit fly. It is expected that one of the first acts of the Federal Government will be to deputize the entire State force, thus giving them Federal power and authority, though these men will still remain State officials. It is to be hoped that those in charge of the quarantine work at Washington will see fit to provide for the immediate appointment of a quarantine officer, who shall have general supervision of the entire quarantine work of the Pacific Coast. Through such appointment it will be possible to maintain an efficient quarantine, not only at the California ports, but along the entire Pacific Coast and also along the western Mexican border. The Commission has had several conferences with Dr. C. L. Marlatt of the Bureau of Entomology, and is highly pleased with the genial and hearty coöperation of that Bureau. We look forward to this as one of great import to California quarantine. Through harmony and efficient coöperation with the Federal Government, the State Commission of Horticulture expects to continue to afford the same efficient and consistent protection to the State fruit growers as it has exercised in the past.

ANNUAL REPORTS OF THE COUNTY COMMISSIONERS.

October 1st is the time set for all the county commissioners to make their annual reports to the State Commissioner of Horticulture. In order to have these reports uniform and to cover a like scope, the Commission has prepared a blank form which was sent to each of the county commissioners. This form asks for reports on the following items: The number of bearing and non-bearing trees, together with this season's crop in pounds; the names, amount of damage, means and cost of control of insect pests and plant diseases; number of horticultural products inspected, condemned and causes of condemnation, which have been received into the various counties this year; and the amount of work and salary of the various county officials.

These reports are daily reaching the Commissioner's office and will become a great asset in ascertaining information at first hand relative to the exact status of the horticultural welfare of this great State. So far the reports are very thorough and satisfactory, and we trust that all will be in by the first of November.

PARCELS POST AND HORTICULTURAL QUARANTINE.

On January 1, 1913, the parcels post will become operative throughout the United States and its various possessions. It will then be possible to send eleven pounds through the mails. This passage of a parcels post we believe to be of great benefit to the agricultural interests of the entire country and especially to the rural farming districts. There is one consideration, however, which must not be overlooked, and that is the matter of the inspection of horticultural products which may be transmitted in this way. Under the National Quarantine law it is possible for the Secretary of Agriculture to establish certain foreign and interstate and territory quarantines. We are very much concerned to know whether the post office department will be under the jurisdiction of the quarantine law, as are other common carriers. Naturally we would suppose this to be true, but no mention is made of this matter in the National Law. In order to ascertain this information at first hand several letters have been written to the Secretary of Agriculture, the Chief of the Bureau of Entomology, and the Postmaster General, at Washington, D. C., by members of the State Commission of Horticulture, and also by Honorable William Kent. So far the Postmaster General has not made any statements concerning the relations of his department to the Federal Quarantine law, but reports that our request will receive due consideration and that the entire matter is now in the hands of a committee; therefore, we are yet uncertain as to the exact outcome of this matter.

If it were possible to originate parcels post shipments of horticultural products in quarantined districts, the purpose of the National Quarantine law would be partially defeated in this way. Other shipments of horticultural products coming from one state to another without proper inspection would also be a menace to our horticultural interests. In view of the evident importance of this matter, it is not likely that the post office department will in any way jeopardize the agricultural interests of this country, and though we have not yet heard definitely regarding this matter we expect to know within a few weeks. We are presenting this information, not to cause any undue alarm or criticism, but simply to show the seriousness of the situation and to call attention to the fact that the matter is being conscientiously considered by those who have the interests of this State at heart and especially by the heads of the Post Office Department and the Department of Agriculture.

NEW SUBSCRIPTIONS FOR THE MONTHLY BULLETIN.

The demands for The Monthly Bulletin continue to come in in great numbers. We are glad of this because it shows that the publication is appreciated. It is our earnest desire that every interested fruit grower in this State should receive it, and are exerting every effort to see that none are refused.

Due to the large number of unexpected requests, several issues have already been exhausted and applicants who do not receive the issues requested will understand the reason. Applications should be at least one month ahead for the next mailed issue. Those desiring change of address should make same known to this office at least one month or six weeks in advance, in order to avoid complications and delays. We will be glad to have all errors in mailing reported to this office in order that we may make the corrections promptly, and trust that the public will appreciate our efforts to conduct this periodical in as businesslike manner as conditions will admit.

DIVISION REPORTS.

The large demand for The Monthly Bulletin is becoming so great that it is now necessary to exclude much that we would like to publish for the benefit of the fruit growers. It is necessary to reduce the size of the publication in order to enlarge the edition. To do this the reports of the Quarantine and Insectary Divisions will not be published from now on, but will be filed as in the past. Any one desiring information regarding these may obtain such by addressing the Commissioner.

All articles will be rigidly edited so as to make them as concise and to the point as possible. Will not all the contributors aid the editor in this matter? We want to make The Monthly Bulletin as valuable as possible.

CORRECTIONS.

The following corrections to article entitled "Host Index to California Coccidæ," by C. F. Baker and E. O. Essig, published in The Monthly Bulletin, Vol. I, No. 10, pages 740–763, are offered:

On page 754, *Phenacoccus marlatti* should be *Phœnicoccus marlatti*.

Prof. Theo. D. A. Cockerell, who has called our attention to this mistake, also believes that the scientific name of the long-tailed mealy bug is not *Pseudococcus adonidum*, as is included in the above index. Our reasons for giving it this name are found in an article of the Journal of Economic Entomology, Vol. II, page 431 (December, 1909), written by J. G. Sanders, then of the Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C., where this name is given as the right one.

Under title of The Quarantine Division, in the same publication, on page 812, *Aspidiotus lantaniæ* should be *Aspidiotus latania*.

THE RASPBERRY HORN-TAIL.

(Hartigia abdominalis)

ORDER—Hymenoptera. Family—Siricidæ.

By E. O. Essig.

Introduction.

From the first of February until the latter part of March numerous reports reached the Commission relative to the damage done to raspberries and blackberries by a certain "fly," which was afterwards found to be a horn-tail. The matter was definitely called to the attention of the writer by Mr. H. H. Bowman, horticultural commissioner of Placer County, who sent a consignment of infested raspberry canes for inspection. These canes contained the larvæ and pupæ of last year's brood, which began to hatch about the first of April. Adult males and females were sent to Mr. F. H. Chittenden of the Bureau of Entomology at Washington, D. C., who determined the species as *Hartigia abdominalis*.

Information and specimens from other sources showed that the insect was generally distributed throughout the central and northern foothill counties, and the damage caused by its depredations warranted a study such as is herein presented.

Work.

The principal damage is done to the young and thrifty new growth or canes sometime before the appearance of the blossoms. The initial injury is produced by the first hatched larvæ which bore spirally around and down the cane in the cambium layer until the middle pith is reached. The complete girdling of the growing part of the shoots causes them to die within a few days; the portion above the spiral being completely destroyed. (Figs. 276, 277, and 278.) Upon entering the pith the larva first ascends to the tip, or if the shoot dies before the extremity is reached, it retraces its path and continues on down the pith, but causing no apparent damage.

Destructiveness.

Though the raspberry horn-tail is a comparatively new pest, no doubt it has been present in the raspberry fields for several years, but it was not until last year (1911) that the growers noticed it. So many of the canes began to die back in the spring that great alarm was caused and immediately help was asked. Fortunately the attacks were

on and near the place owned by H. H. Bowman, County Horticultural Commissioner of Placer County, and he began at once to study the cause as well as methods of control. In spite of the attack the bushes recovered, sending out new shoots just below the spiral made by the larvæ and a good crop was produced—though many of the canes were

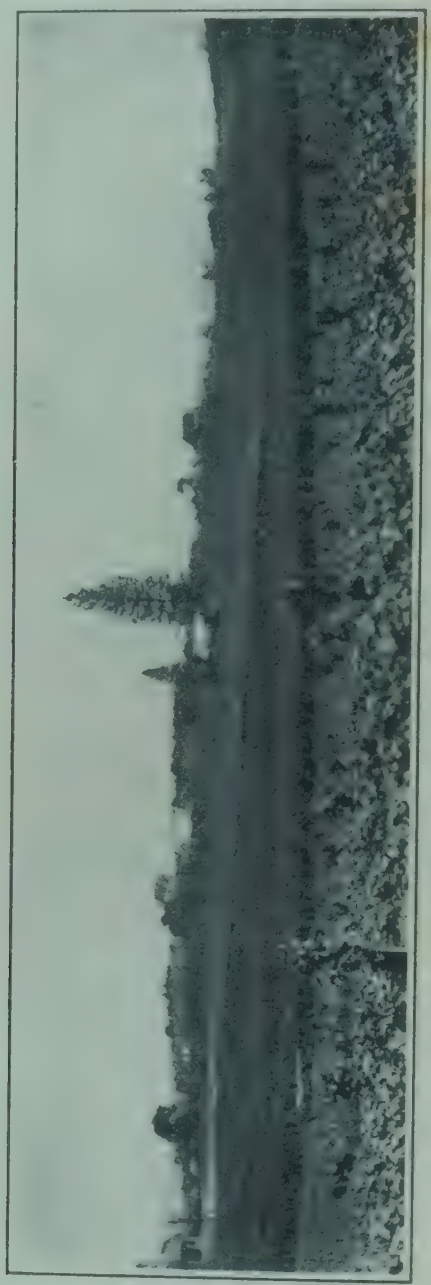

FIG. 275. Typical raspberry field at Bowman, Cal., where nearly ninety per cent of the canes were infested by the horn-tail this year. (Original.)

killed outright, thus causing some loss. Careful observations of practical growers, and especially by Mr. Bowman and the writer, convinced us that the actual damage done has not been great, yet we are at loss to say what the future may have in store. Though nearly every young and thrifty shoot in large fields was killed back from six to twenty inches,

it was found that below the spiral several small branches appeared, which grew very rapidly and which produced quantities of fine berries. Canes not affected by the horn-tails failed to throw out these spurs and produced earlier and larger berries, in somewhat greater numbers. The greatest loss is due to the setting back of the ripening period, which may be from several days to over a week.

FIG. 276. Vigorous shoots killed by the raspberry horn-tail. Most of these shoots attain a height of three feet before the tops begin to die. (Original.)

Description and Life History.

Eggs (Figs. 280 and 281).—The eggs are glossy, pearly white in color and flattened oval in shape with the end coming last from the ovipositor, curved and sharply pointed. The skin is so delicate that it is difficult to study the egg without breaking it. The length is about one sixteenth of an inch, and the greatest breadth is equal to two thirds the length. They are inserted in a slit just beneath the bark or skin of the young canes. This slit is made by the ovipositor of the female—the egg being inserted by the same instrument.

In making the insertion the egg is forced slightly downward from one-

sixteenth to one-fourth of an inch from the opening of the slit. The position of the egg in the tender shoot is very easy to locate, due to the discoloration of the injured tissue over it. In many instances, however, the egg is so near to the surface that a swelling, corresponding to its size, is produced above. In such instances the swelling assumes a whitish to a yellowish-brown color (Fig. 280).

There is usually only one egg inserted in a cane, but in a few cases two have been found. The point of insertion is generally near the

FIG. 277. Showing the average condition of the canes in a large field—practically every tip being killed. (Original.)

second or third leaf axil and within six or eight inches of the tip. If the shoot is not killed the point of insertion and spiral may appear close to the ground, due to the rapid growth of the cane.

The eggs are deposited in the first tender shoots or canes. At Bowman, California, egg-laying begins the first of May and continues until after the middle of the month.

Larvæ (Figs. 282, 283 a and 284 e and f).—The newly hatched larvæ are very minute but attain a length of about one fourth of an inch before

they leave their hatching places. The color is first yellowish-green, gradually becoming white with age. When full grown the length is from three fourths to nearly one inch. They make a cylindrical burrow, slightly less than one eighth of an inch in diameter. (Fig. 279 b and c.) The shape is characteristic of all horn-tails, being nearly that

FIG. 278. As fast as the new shoots appear they are attacked by the horn-tail. This photograph shows the largest or earliest and the smaller or latest shoots dying from the infestations. (Original.)

of a letter "S." There are six true legs near the head with aborted legs on each abdominal segment. The tail ends in a peculiar dark point, as shown in the accompanying illustration. (Figs. 282 and 284 e and f.)

Upon hatching the larvæ remain for a while near the place of birth, feeding upon the surrounding tissues, but never disturbing the outer skin or bark. After attaining a length of nearly one fourth of an inch they begin their downward journey, by burrowing in spirals around the canes, destroying the thin cambium layers. These spirals (Fig. 279 a) may consist of from one to three complete rings, which may be compact, occupying one half inch of the length of the canes, or if loose, occupying more than one inch. In making them the larvæ continually work toward the pith in the middle of the canes. When this is

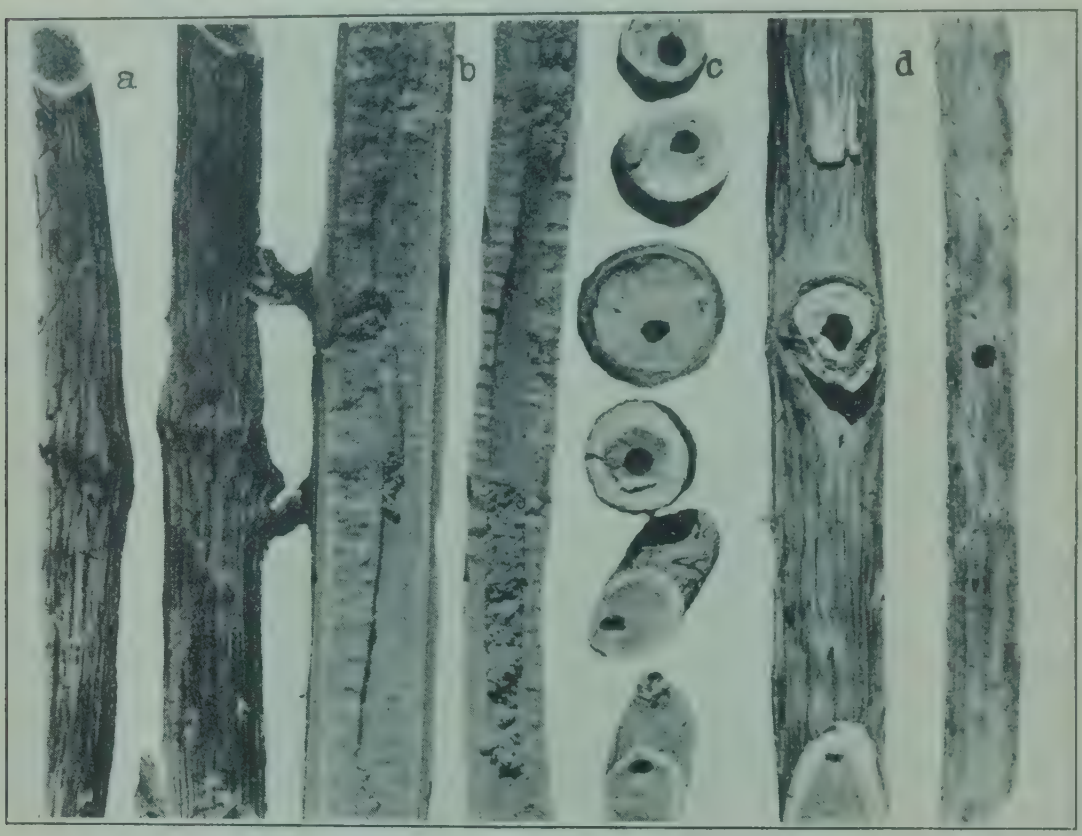

FIG. 279. Old canes showing the work of the horn-tail. a, spirals made around the canes in the cambium layer by the young larvæ; b, burrows in the pith of the old canes made by full-grown larvæ; c, cross-sections of canes to show burrows; d, holes gnawed through the sides of the canes through which the adults escaped. (Original.)

reached the course is turned upward in the pith to the tip of the young shoot, which wilts and dies, often before the extremity is reached. It thus appears that the young stage requires tender and healthy tissues for food. As soon as the branch is dead the larvæ turn and retrace their paths downward, working on the middle pith alone, all of which is digested or converted into frass behind. The length of the burrows vary considerably. In most cases the larvæ stop within one or two feet of the ground for pupation, while in others they may continue to the surface of the soil or to the very roots. During this downward path apparently no damage to the cane is done.

The larval stage occupies most of the summer months, from April to October, though during this period there are many overlapping broods. The average age for each larva is from four to six months.

Pupæ (Figs. 282, 283, and 284 c and d).—When ready to transform or pupate the larvæ become inactive and soon spin a thin white silken cocoon or web within the burrow. The transformation requires from one to two months. When fully developed the adult insect gnaws a hole through the side of the cane (Fig. 279 d) and escapes.

Adults (Figs. 274, 284 a and b, and 285).—The adults are four-

FIG. 280. Discolored areas showing the locations of the eggs in the tender shoots. (Original.)

winged insects, often mistaken for wasps because of their slender bodies and yellow and black markings. They begin to appear as soon as the weather becomes warm in the spring—last year in April and were still plentiful in August, after which scarcely any were to be observed. In the heat of the day they become very active, the males being easily observed flying about, while the females are usually to be found ovipositing on the tender shoots.

*The horn-tails (*Siricidæ*) are easily distinguished from the common saw-flies (*Tenthredinidæ*) by the single spur at the inside base of the front tibia—the saw-flies having two spurs similarly located.

*According to Kellogg, the families *Siricidæ* and *Tenthredinidæ* are replaced by the superfamilies *Siricicoidæ* and *Tenthredinidoidæ*, while S. A. Rowher inculdes both in the superfamily *Tenthredinoidæ*.

Females (Figs. 284 a and 285).—The adult females average five eighths of an inch in length, the wing expanse being about the same. The body is decidedly slender throughout, though the abdomen enlarges ventrally near the posterior end but does not become wider. The color is black and yellow, the latter predominating. The accompanying drawing (Fig. 285) gives an exact idea of the pattern.

The head and eyes are black, there being two yellow bands nearly encircling the former, but broken directly in front and above. The middle front of the head is yellow. The antennæ have the basal and apical thirds black, while the middle third is amber. The prothorax is black with a yellow spot on each side at the base. The mesothorax is black with a yellow spot in front of and under the base of each wing, and a bright yellow, nearly circular, spot in the middle of the scutellum.

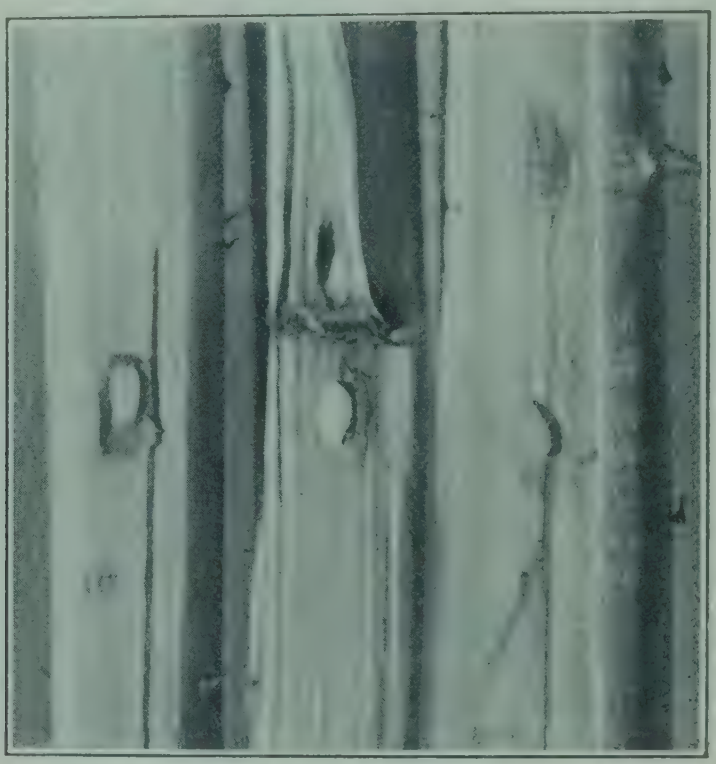

FIG. 281. The eggs of the raspberry horn-tail. The thin skins of the shoots have been removed—the eggs remaining *in situ*.

The metathorax is black with a yellow spot, in shape not unlike an inverted top, on the dorsum, and two small yellow spots in front of the tip of the large one. There are also two lateral yellow spots under the hind wings. The coxæ, trochanters and femora of the legs are black; the tibiæ and tarsi are amber with bases of the former yellow. The abdomen is generally yellow with dark bands and markings. The extreme ventral portion throughout its length, including the last segment, is black. On the dorsum there are several pale dark markings at the bases of the first and second abdominal segments, and a large crescent-shaped black blotch at the base of the third. The fourth segment is

entirely black, while the basal halves of the sixth and seventh segments are of the same color. On the dorsum of the latter the black marking may or may not extend to the eighth segment. The last segment besides bearing the ovipositor has two short black tubercles on each side. The wings are dusky amber and hyaline, with venation as shown in the drawing.

Males (Figs. 274 and 284 b).—The males are noticeably smaller than the females, the length averaging about one half an inch. The body is slender and nearly cylindrical throughout. The general color is black with yellow markings. Those on the head are similar to those of the female, though smaller. The antennæ are black throughout. The markings of the thorax are usually wanting, with the exception of the top-shaped yellow spot on the dorsum of the metathorax. In a few cases, however, all of the spots of the female may be faintly indicated excepting the large spot on the scutellum. The legs are black with the exception of the tibiæ and tarsi, which are dark brown. The abdomen is jet black, excepting two yellow spots on the second segment, which nearly meet at the top, and a narrow yellow broken band extending over each of the posterior dorsal halves of the third and fifth segments. The band on the third segment is often broken on the dorsum, forming but two lateral spots. The upper half of the last segment—the portion above the ovipositor—is also yellow. There are two small dark tubercles on each side of the last segment.

Distribution.

At first it was thought that the horn-tail occurred only in the higher altitudes of the foothill regions, but further investigations show that it also occurs in various sections of the lower Sacramento Valley. At present it is a pest only in the higher altitudes of Placer, Amador, and Nevada counties. It has also been reported as occurring in Tehama, Butte, and Sacramento counties, where some damage is being done. Without doubt the insect is present to some degree in the entire northeastern part of the State east of the Sacramento River.

Food Plants.

Like many native insects this pest has found cultivated plants more suitable to its liking than the native hosts. So far only one native food plant has been reported and it proves to be the wild rose. If there are other native hosts they probably belong to the family *Rosaceæ*, and might include such plants as the wild raspberry, blackberry, thimbleberry, etc.

At present the most damage is being done to the raspberry fields in the higher altitudes where such berries are raised to a considerable extent.

In many of the fields in Placer County over 90 per cent of all canes were affected, and during the early part of the year it appeared that the entire crop would be attacked.

FIG. 282. The fully developed larvæ and the pupæ *in situ* in the burrow. (Original.)

The horn-tail also works on rose bushes, entirely destroying the year's bloom.

In Sacramento they were found attacking the canes of blackberries in the same manner as in the raspberries and roses. Loganberries are also among the hosts.

Control.

The first remedy suggested was to trim off all infested canes as soon as they began to show the effects of attack. Some of the growers did this more or less thoroughly last year, but this spring the attack was even more severe—from 80 per cent to 90 per cent of all young shoots being

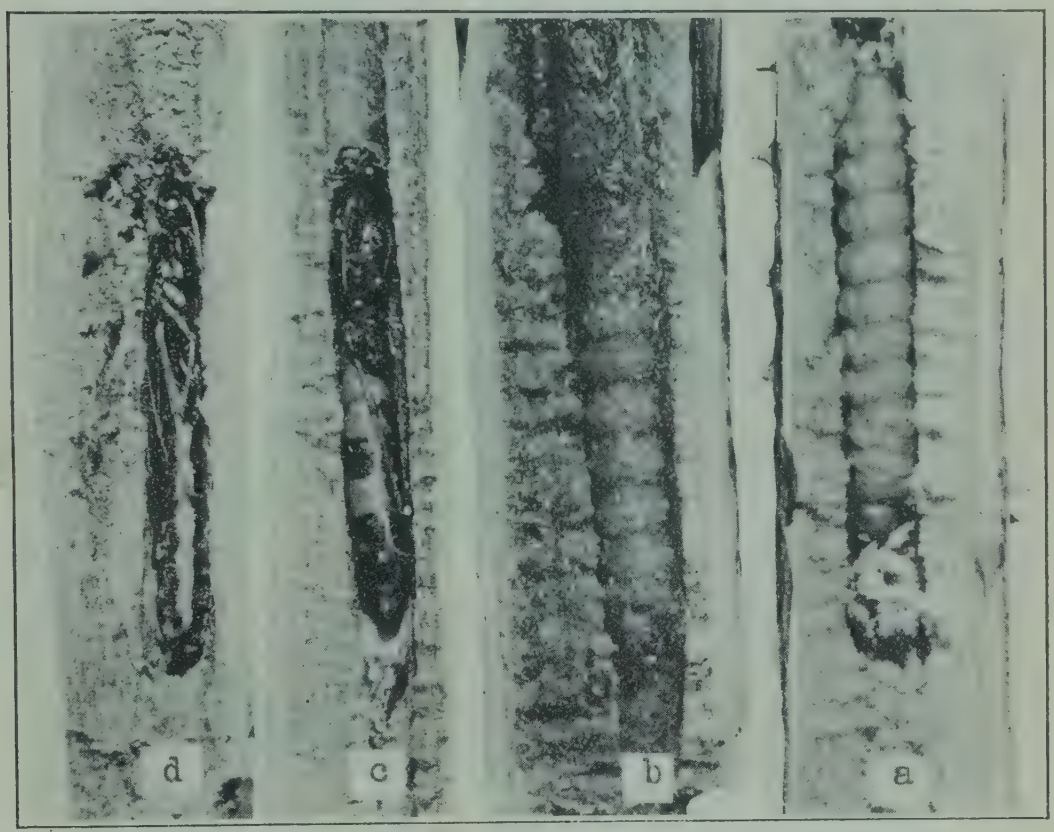

FIG. 283. The various stages of the horn-tail which are commonly found in the burrows of the old canes in late winter and early spring. a, larvæ just beginning to pupate; b, early stage of the pupa; c, female nearly ready to emerge; d, male nearly fully developed. (Original.)

affected. Large numbers of the canes were promptly removed, but no thorough cutting-out test was made.

Should the pest continue to increase, as in the past two years, the attacks may be such as to completely kill the young shoots soon after they come through the ground. This would be accomplished by depositing many eggs in the shoots at various stages of their growths, and thus successively girdling them with the spirals. The growers are warned to keep careful watch, especially during egg-laying season (April and

May), and if the above conditions exist to begin at once destroying the freshly laid eggs.

The fact that the eggs are easily and quickly located soon after laid, and that they are very easily crushed, makes it possible to quickly destroy them by a slight pressure exerted by the thumb or finger over the discolored area. This would in no way impair the growth of the shoots, and appears to the writer to be the proper procedure in control-

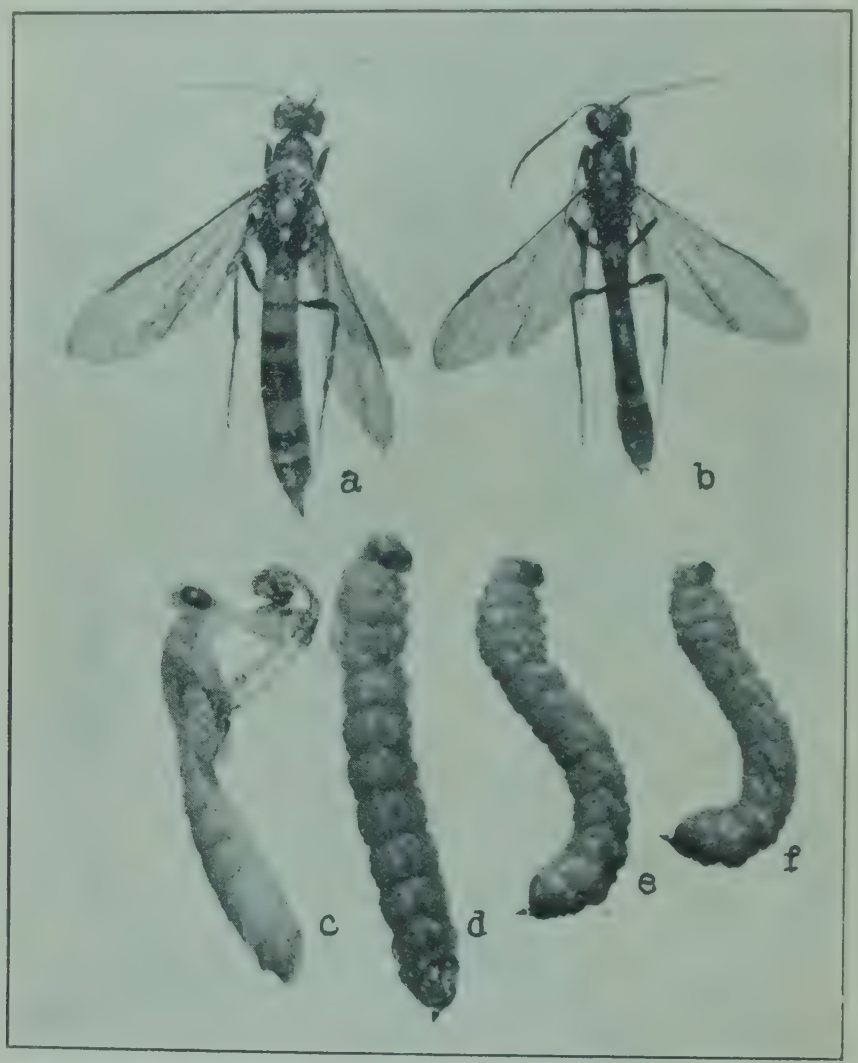

FIG. 284. The raspberry horn-tail (*Hartigia abdominalis*). a, adult female; b, adult male; c, well developed pupa; d, very young pupa; e and f, larvæ. (Original.)

ling the pest. One person could easily eliminate thousands of the eggs in a very short time.

Some have sought to eliminate the pest by cutting out the older canes in the winter. While this is effective to some degree, it is often an expensive practice, in that many canes are removed by mistake which would otherwise bear fruit the next year. The dead canes are the only ones which can profitably be removed during the winter months.

for it is absolutely impossible to greatly lessen the numbers of adults by cutting out old canes, unless practically all of them are removed. Mashing the eggs in the spring is much more to be advised, from the fact that it seldom happens that more than one egg is placed in a single shoot. Whether the females will oviposit in a shoot again after an egg has been destroyed, remains to be worked out, but naturally she seems to avoid placing two eggs in the same cane. It is much easier and quicker to mash the egg than to nip off the young shoot or to trim out the old canes, and the important thing about this process is that the cane

FIG. 285. Adult female of the raspberry horn-tail, showing color pattern and structural details.

is not injured in the least, so that if the work is thoroughly done there will be no dimunition of the crop output, which of course is the first consideration.

Acknowledgment.

I wish to take this opportunity to acknowledge the generous and valuable help of Mr. H. H. Bowman, county horticultural commissioner of Placer County, who has helped to make this investigation possible, and who is responsible for much of the information contained in this article.

AN OUTLINE OF THE STATE QUARANTINE SYSTEM AND A RECORD OF ITS WORK.

By Frederick Maskew and Clare E. Dutton.

Developments at the Fruit Growers' Convention held at Santa Barbara in June, 1912, brought out, during the discussion of the Mediterranean fruit fly, the fact that but little is really known, even on the part

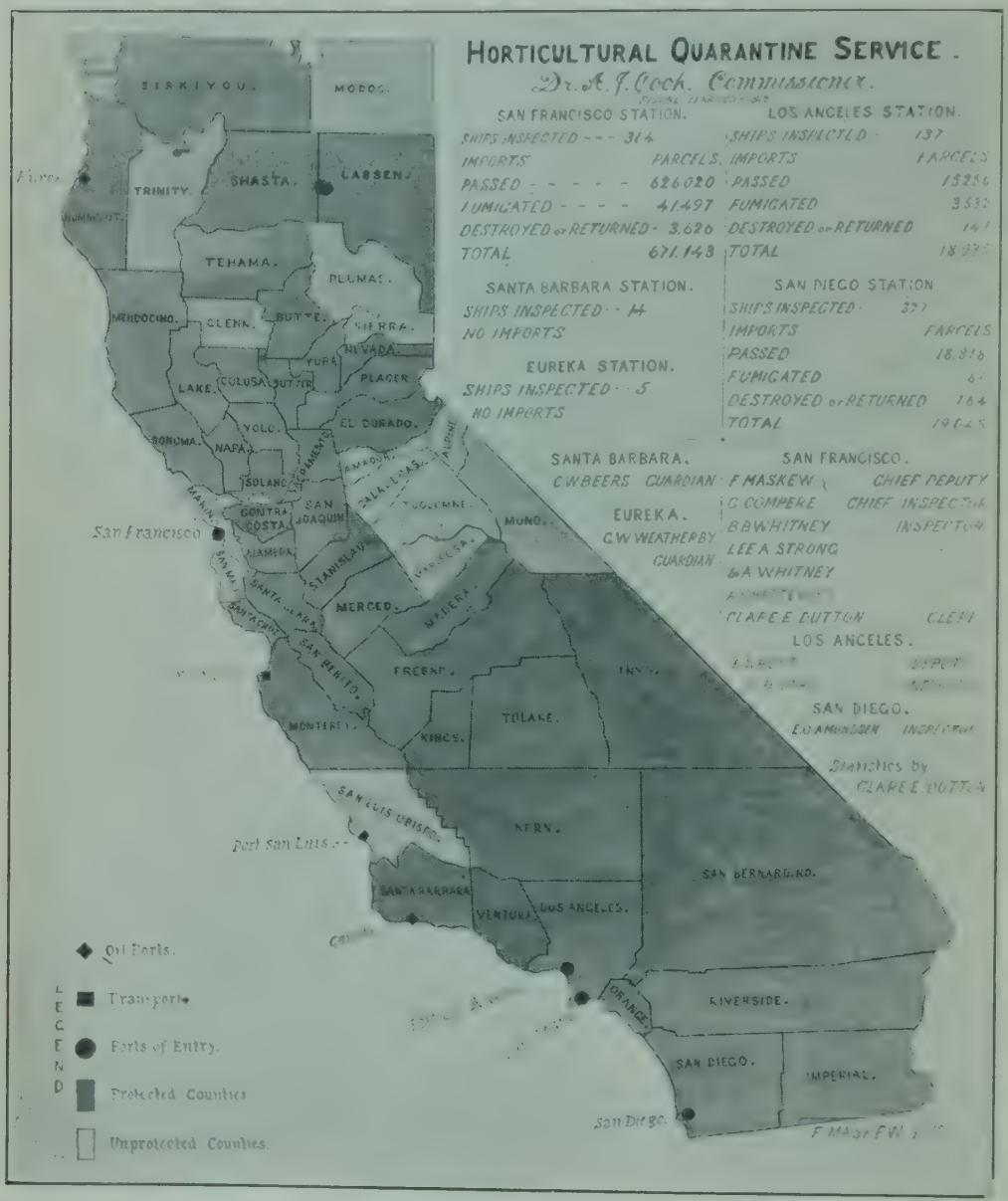

FIG. 286.—Map showing an outline of the State Quarantine system of the California State Commission of Horticulture and a record of its work.

of those most vitally interested in the matter—the fruit growers themselves—of the extent and thoroughness of the horticultural quarantine service of the State of California. Throughout the horticultural cen-

ters of the world to-day the system that has been so carefully and persistently built up and maintained in California is recognized as the most perfect of its kind in existence, and to the end that those who contribute to its maintenance may have a clearer idea of the details of the service and of the measure of protection it affords, the map (Fig. 286) which accompanies this article has been prepared by the authors, and the following explanation of the same is herewith submitted:

At the present time the most convenient avenue of entrance, which we most dread, for the foreign insect pests and plant diseases is through the medium of the coast ports. Realizing this, fruit growers become nervously anxious as to how it is possible to successfully watch every harbor situated on a coast approximately one thousand miles in length. For their future peace of mind we refer them to the map, and call their attention to the fact that there are but five ports of entry on the California coast. Every vessel of any kind coming from a foreign port must first enter one of these five ports and report to the United States Customs. Each vessel upon its arrival finds in waiting a state horticultural quarantine officer competent to pass upon the health and cleanliness of whatever horticultural products are on board, and whose knowledge of the details of marine architecture enables him to promptly locate such articles, and who in conjunction with the United States Customs officials immediately searches the belongings of the passengers and the stores of the ship. In conformity with section 1 of the State Quarantine Law, each vessel upon its arrival, must furnish a manifest (a sworn statement), itemizing all horticultural products carried in the vessel as freight, and the same when discharged from the ship are held upon the dock until they have all been inspected and either released or condemned, as the findings in each individual case may warrant.

There is one exception to this rule governing the entrance to California ports other than ports of entry on the part of vessels arriving from points outside of California. This occurs at Port San Luis in San Luis Obispo County and at Gaviota in Santa Barbara County. These are indicated on the map as "oil ports," and the general ruling is abrogated by reason of the fact that the only vessels from foreign ports permitted to land here are oil tankers with no license to carry passengers and no facilities to carry freight. In view of these facts the United States Customs does not maintain a corps of surveyors or appraisers at either point. However, every vessel arriving from outside the State lines is met and inspected by a Federal health officer. The horticultural quarantine service also has a guardian who meets, inspects and reports upon all vessels arriving at Gaviota. In the matter of contraband horticultural products, the situation is covered at Port San Luis by an agreement between the Associated Transportation Company owning the oil vessels using that port and the horticultural quarantine service, to the effect that the company issued an order to the captains of all their vessels on September 8, 1911, which reads as follows: "From now on it will be against the rules of this company for you or any of your crew to

bring ashore any fruits that are put on board your vessel at Honolulu. Any infringement of this will mean expulsion."

So far in this matter of quarantine work on ships from all foreign ports, we are always ably assisted by the United States Customs officers, but with the domestic traffic this capable coöperation comes to an end. North Pacific ports, Hawaiian and Philippine ports are domestic to the Federal officers, but with the State quarantine officers their exports are all subjected to the closest inspection. It is a difficult matter for the average citizen to grasp the significance of the fact that Honolulu is a domestic port and that all travelers can pass from there to any United States port with as little hindrance as from San Francisco to Oakland, excepting only the matter of the health officer. Whatever belongings they may see fit to bring with them (providing they come in a vessel that has not called at any foreign port), are immune from any interference or inspection on the part of the United States Customs, and neither the ship nor the crew is watched by these same authorities. Herein has lain the danger of introducing the Mediterranean fruit fly, and to obtain access to the contents of the personal belongings of all passengers and members of the crews in these instances for the purpose of intercepting all material that might carry the flies, was a problem that taxed the ingenuity of the horticultural service to the utmost. But where there is a will, a way can usually be found, and this hitherto insurmountable obstacle—the sacredness of private property—was overcome in this instance through the coöperation of the officials of the Matson and Oceanic steamship lines with the quarantine officer. This privilege—for it is not a right by any means—was acquired in the following manner. Each ticket issued by these lines and good for a passage from Honolulu to San Francisco, has printed upon it a condition, whereby the purchaser in accepting the ticket agrees to submit all of his baggage to the inspection of the horticultural officers of California before leaving the dock at San Francisco. This procedure has been diligently carried out, and up to date has done more than probably any one thing to keep the fruit flies out of the State. It is, however, the weakest point in the quarantine system, and every effort should be bent to make this searching of Honolulu baggage a right by legal action, and not a privilege obtained by concession.

The regular army transport docks are located at San Francisco. However, the port of Monterey is marked upon the map as a transport landing. This was done for a special purpose. To our personal knowledge certain poorly-informed persons assiduously circulated the report that vessels from foreign ports were landing at Monterey, and that no one was there to prevent the fruit flies from being brought into the State at that point. Such are not the facts. United States army transports from Manila via Honolulu are the only vessels arriving from fruit fly regions that land at Monterey, and only one of these has done so during the past fiscal year. "General Orders No. 3," issued by the United States Quartermaster's Department, reads as follows: "All army trans-

ports are *prohibited* from bringing or having on board any fruits or vegetables that are known to be hosts of fruit flies.'' The results obtained by our searching of all transports that have arrived at San Francisco during the same period, furnish ample evidence that the provisions of this order have been rigidly enforced, and leave no grounds to believe that the one which landed at Monterey was an exception to the rule. Further, a corps of United States Customs surveyors, each one of which is acquainted with the appearance of contraband fruit and the regulations governing its disposition at all California points, are always detailed for duty at that particular port whenever any one is to land from an outside point.

In the matter of horticultural imports by sea, it may be well to reiterate the statement that the manifest furnished the quarantine office by each vessel promptly upon its arrival indicates the nature, extent and origin of such material, and the inspector having this information some time in advance of the actual landing of such imports, can take proper precautions for their inspection, treatment and final disposition. Practically a lifetime of experience has taught the old quarantine officers what insect pests and diseases to expect on any class of horticultural products from almost any part of the world, and what is equally important, on what part of the material to look for them. The major portion of all this material is dutiable, consequently, there is abundant time in which to carefully search the shipment. With the freight as with the passengers' baggage, the horticultural products from Honolulu are the paramount issue at all times. Practically the only imports arriving at the present time are bananas and fresh pineapples. All other products, excepting root crops, being quarantined against. All fresh pineapples destined for California points are fumigated heavily as a matter of insurance before they leave the dock. A standard of condition and class of wrapping is established for bananas. At San Francisco a man is specially detailed to make a thorough inspection both on the dock and into the storerooms of the commission district, and devotes all of his time to the banana imports from the Atlantic seaboard, and from Mexico as well as from Honolulu.

With a horticultural quarantine officer at each of the five ports of entry; one at the oil port of Gaviota; the coöperation of the officers of the oil ships at Port San Luis and the general orders in force on board any army transport that might land at Monterey, the situation as it concerns the matter of fruit fly or any other orchard pest, both in passengers' baggage, in ship stores or the horticultural products carried as freight is systematically controlled at the present time, and fruit growers may rest assured that from the foregoing standpoint the one thousand miles of the California coast line are under better surveillance than any other similar section of the United States, and perhaps of the entire world.

It must not be inferred from the foregoing that a State quarantine officer is concerned only with horticultural imports arriving by sea. A

glance at the monthly reports of the division already published in The Monthly Bulletin will promptly remove any misapprehension on this point. The imports by rail are heavy, and the nature of the material varied. The insects which often take advantage of this method of distribution are in some instances second only in the matter of destructiveness to the fruit flies themselves, and must be kept out of the State at all hazards. It is not our purpose to enumerate these or their habits in this article, but to call attention to the numerous entrepôts and to the methods employed to intercept the consignments. The quarantine officer in San Francisco is notified of each shipment in bond of living plant material en route to California from Europe via the Eastern seaboard in time to intercept, inspect and dispose of it, or, if outside his immediate sphere of action, to notify the quarantine officer of the county embracing its point of destination. All horticultural products from foreign countries coming to California and Hawaiian points by parcels post are routed through San Francisco, and are held by the authorities there until examined and passed by a State quarantine officer. Every carload, each individual parcel, of horticultural products; even returned goods coming into California from outside the State lines, by freight or express are held by the agents of these transportation companies for inspection by the State quarantine officers, and an itemized record is kept of the same, together with the findings and action taken on each individual shipment. The volume of these imports can be seen at a glance by referring to the tabulated statistics for the fiscal year set forth on the map (Fig. 286). The handling of this mass of material with the discretion, thoroughness, and dispatch that the nature and importance of the work demand, as also the obtaining and maintaining of the interest and coöperation of the infinite number of agents connected with the work of distributing the same, and without which the service would be far from complete, calls for the constant exercise of such tact, judgment, and cumulative experience as to make the quarantine service essentially a businss rather than an occupation.

We have attempted on the map to show the counties having County Horticultural Commissioners, as compared with those counties that, at the present time, have not. In the legend they are designated as "Protected counties"—"Unprotected counties," and it was the intention to locate their relative positions by a difference in the shading. Out of a total of fifty-eight counties in the State, forty-two at the present time have active, working county commissioners. Their connection with this article is that each and all of them have been commissioned to act as State quarantine guardians, and under section 1 of the State Quarantine Law, they are to be notified of the arrival into the territory under their jurisdiction of all horticultural products coming from outside the State lines, and are fully empowered to act in relation to the same, according to all the provisions set forth in the same law. These officials, by reason of long experience and much practice, have become experts in the matter of the productions peculiar to their counties, and by diligent study have

acquired a wide knowledge of the pests and diseases affecting these same products in other parts of the world, and are also constantly on the watch to prevent the introduction of the same through the many channels offered by modern commerce. Though in most instances unrecorded, their prompt action has resulted in preventing the planting in California of many an infested shipment of trees and plants, and has thus very materially helped to prevent an increase in the cost of crop production, which is the prime purpose of the quarantine service. This augmentation to the forces of the State quarantine division, together with the newly-enacted National Quarantine Law, practically completes the scope of the work and furnishes a protection of its kind that is unprecedented in the annals of horticulture.

A FEW FACTS CONCERNING THE FRUIT FLIES OF THE WORLD. III.

By George Compere.

Reasons Why the Staphylinid Beetle (*Huamerocera brasiliensis*) Did Not Become Established in West Australia.

As previously mentioned, when on July 6th I turned the little insectary at Perth, West Australia, over to an assistant, there was a fine lot of healthy Staphylinid beetle larvæ. I gave full instructions how to care for these beetles and larvæ, so that when the fruit fly began to make its appearance in the spring there would be a good supply of the beetles to liberate in the infested orchards.

On July 6, 1905, I again left Perth for a trip to China, with the intention of going into the interior of the latter country in quest of parasites of the various species of scale insects, which were causing so much damage to the orchards of both California and West Australia. I calculated to be absent from Perth for at least a year, as it was my intention to visit California before returning. On the way from Sydney to Hongkong our steamer called at two ports at German New Guinea, and I spent a day at each in search of insects, and no less than four species of fruit flies were captured on the wing. The want of time prevented my learning the host fruits of these flies.

August 26th I arrived at Hongkong, and from there I began to make trips in various directions. Upon my return to Hongkong from a trip up the Canton River I found among my mail a personal letter from a friend at Perth informing me that as soon as I had left that place my assistant had absolutely neglected the Staphylinid beetles and that they were all dying for want of food. The great importance of this matter compelled me to make an unexpected return to Perth and see for myself what was being done. I secured passage on the first steamer leaving Hongkong for Australia, October 4th, and arrived at Perth November 6th.

I at once began making an investigation of the conditions in the insectary and the manner in which the Staphylinid beetles and their larvæ had been cared for during my absence. I found the insectary vacant, with the exception of a few empty fruit boxes and an old kerosene can with one end cut out in which had been placed some bones. There was not a single Staphylinid beetle or larvæ left in the place, and inquiry elicited the fact that after my departure from Perth the man in charge had neglected to provide food for them, other than the old meat bones found in the kerosene tin above mentioned.

When Mr. Despeissis, the horticultural and viticultural expert for the department at that time, learned that the beetles had been neglected he collected what adults were yet alive and liberated them in some of the orchards infested with the fruit fly. But there was no way of determining whether the bettles liberated were the progeny of the beetles brought from Bahia, or whether they were the same specimens. No one could inform me if there were any females among them, or if they were all males. However, no beetles were ever found in the places where liberated. Thus perished the work of years of hardship, toil and care as well as the great financial output, all of which could not be regained, though the irresponsible party was dismissed from the service. This one example shows that as much depends upon those in charge of the breeding and rearing of the parasites as upon the one who collects and sends them to the insectary.

The results of the dismissal of the negligent party brought about charges against the further importations of parasites. An advisory board was accordingly appointed, which immediately began an investigation of the charges, and on May 25th reported that the consensus of opinion was that it would be most unwise to interfere with the progress of work showing such good results in the past and promise for the future.

Natural Enemies of the Fruit Fly Discovered in China and India.

On May 29th I again departed from the State, going to China by way of Sydney and taking with me trees infested with red and black scale on which to establish any parasites that were to be obtained in China and India. I made Hongkong my headquarters, placing the trees in the care of a Chinese gardener to look after while I was away.

On August 16th I started from Hongkong for a trip to India to secure red, purple and black scale parasites to take back to Hongkong and establish on the scale brought there from Australia. While at Bangalore, India, I devoted a great part of my time to work on the fruit fly parasites there, and especially to one particular species that I had discovered in that country during my first visit. It belongs to the family *Ichneumonidæ*, and at first glance could easily be mistaken for small black ants. The method of attacking the fruit fly maggots was so extraordinary that from its first discovery it gave me great encouragement, for there was no reason why other species, attacking the Mediterranean fruit fly maggots in the same manner, could not be discovered if the

home of that fly could be located. This little parasite I first noticed attacking the maggots of what I took to be the melon and cucumber fly, *Dacus cucurbitæ,* but in this it is possible to have been mistaken, for I afterwards reared *Dacus zonatus* from cucumbers in the same locality, and it is quite possible that the parasites were on the larvæ of *Dacus zonatus*, but there were no adults of that fly reared from the lot of maggots from which I reared the first specimens of this parasite. There did issue some adult specimens of *Dacus cucurbitæ.* These little parasites will enter the fruit, no matter how badly decayed it may be, and search through the rotten pulp for maggots. Whenever they discovered a maggot they would at once attack it and deposit anywhere from five to thirty-six eggs in a single one. Maggots so attacked would immediately leave the fruit, presumably to escape from the parasites. In most cases it would be noticed that when the fruit fly maggots emerged from the fruit the little parasites would yet be attached to them, but release their hold on reaching the open. Upon leaving the maggots they would at once begin to clean and dry themselves. This accomplished, they reëntered the fruit in search of more. The habit of these parasites coming out of the decayed or soft fruits attached to their prey is a provision of nature by which they are rescued from within the soft pulp.

I soon discovered that this parasite attacked various species of fruit fly larvæ in India, but the Mediterranean fruit fly not being in that country, I questioned as to whether it would also attack that. However, I collected quite a lot of parasitized fruit fly pupæ of the various species of flies found in and around Bangalore, India, and on September 16, 1906, I placed them in the cool chamber on board the English mail steamer "Orient," at Colombo, bound for West Australia.

I was aware at the time I sent the parasites to West Australia that there would be very little chance of any larvæ of *Ceratitis capitata* being secured at the time of year that they would arrive, and this proved to be the case. I was afterwards informed by mail that the parasites arrived in splendid condition, but there were no fruit fly maggots on which to liberate them.

After placing the fruit fly parasites on board the steamer at Colombo I proceeded to Hongkong, taking with me the red and purple scale parasites which I had secured in India. While there I spent a great deal of my time in and around the city investigating the fruit flies of southern China. At Macao, a Portuguese possession, *Dacus cucurbitæ* is rather a serious pest, and the same may be said of Canton, but not to the extent it is in the Hawaiian Islands.

Earwigs Destroying Maggots.

At Kowloon, across on the main land from Hongkong, I spent day after day trying to discover what natural agents held the melon fly in check there, but I never discovered any parasitic or predaceous insects there aside from a species of the family *Forficulidæ* (earwigs). This I found at times in great numbers under decaying cucumbers, squash and melons, and I have placed numbers of the individuals in breeding cages

and fed them upon the melon fly larvæ. These earwigs are also found in southern China in fresh manure feeding upon the larvæ of stable flies. From what I have seen of them in southern China I am of the opinion they are a very important factor in the control of the house flies at Hongkong, and also of the fruit flies. I have often found them in the covered ways of the white ants in the forests of China, feeding upon the termites. I never sent any living specimens of the earwigs to West Australia, for the reason that some species of earwigs are serious pests at times in various parts of Europe. One colony which I kept in a large glass breeding jar for months, and fed upon the larvæ of various species of flies, thrived and multiplied very rapidly.

Parasites of Red and Purple Scales.

October 20th I placed on board the Japanese mail steamer "America Maru," sailing for San Francisco, thirteen cases of living plants, well infested with red and purple scale heavily parasitized with several species of Chalcid parasites secured in India and China. These thirteen packages arrived in San Francisco in splendid condition and were taken to Sacramento by Mr. Carnes and placed in an insectary built in John Isaac's yard in that city.

On this same steamer that I placed the thirteen cases of plants above mentioned I took passage from Hongkong to Japan, where I remained until December 1st collecting another lot of red and purple scale parasites. These I brought with me to California and also a large number of aphis feeding *Coccinellids*. I arrived in San Francisco December 17th.

The Mediterranean Fruit Fly—A Most Serious Problem.

During the first two weeks after my arrival in California I had numerous interviews with Mr. Cooper with reference to the fruit fly situation in Australia, and fully discussed with him the question of our ever being able to control that pest by natural enemies. I informed Mr. Cooper at that time that the longer I worked with the fruit fly problem the more difficult it became. Not that I was unable to discover parasites and natural enemies that would attack the Mediterranean fruit fly, but that the great difficulty appeared to be that there was very little hope of being able to discover a specific parasite of *Ceratitis capitata*. While it was true that I had already discovered some very valuable species of parasites attacking other species of fruit flies in India and also in Brazil, yet the fruit fly parasites which I discovered in India seemed to attack most all species of fruit flies occurring in that country. Whether they would also attack the larvæ of *Ceratitis capitata* or not was a question not easy to determine. *Ceratitis capitata* did not occur in India and the Indian species of fruit flies did not occur in West Australia. The introduction of the Indian species of fruit flies to West Australia, and the introduction of *Ceratitis capitata* into India, would have to be avoided. To a certain extent the same obstacle confronted us with the Brazilian fruit fly parasites. While it was true that in Brazil *Ceratitis capitata* did occur, yet it was in company with numerous other fruit flies, and

there the parasites made no distinction between species. It is true that in Brazil it would have been possible to have covered certain trees and only allowed *Ceratitis capitata* inside the cover to attack the fruit, and then liberate the parasites under the same cover and in that way the danger of establishing a Brazilian species of fruit flies in West Australia would or could be avoided, but that would have cost a great deal of money and time to accomplish. This does not apply to the predatory insects which can at any time be introduced without any danger of introducing new species of fruit flies.

Fruit Fly Conditions in India.

It was finally agreed beteeen Mr. Cooper and myself that I return to West Australia and point out the facts to the Director of Agriculture there, and Mr. Cooper gave me a free hand to do whatever I thought best with reference to the fruit fly parasite question.

January 19, 1907, I left San Francisco for West Australia, going by way of Sydney, and arriving at Perth March 11th, and at once took up the matter of the introduction of the Indian species of fruit fly parasites with Mr. Despeissis of the Department. It was decided that an attempt to have the Indian fruit fly parasites introduced to West Australia should be made at once, and to determine, if possible, what ones of the Indian species of fruit fly parasites would attack the Mediterranean species. With the insectary constructed in such a manner that nothing in the form of an insect could escape from the inside I decided to make the attempt. But there yet remained another very serious phase of the subject to be reckoned with—that of the off-season. When there would be *Ceratitis capitata* larvæ in West Australia on which to experiment there would be practically no parasites in India. However, I was given a free hand and instructed to do the best I could with the funds available.

May 1st I again left Perth for India, going by the way of Colombo and taking along with me several small trees infested with red scale, on which I would try to establish the red scale parasites of India if possible. I had no intention of remaining very long in India that time, my main object being to make myself acquainted with the conditions there, and at what section it would be best for me to establish my headquarters.

May 9th I arrived at Colombo, Ceylon, and remained on that island ten days, during which time I discovered and sent to West Australia a parasite of the cabbage aphis, which soon reduced that insect from a serious to a harmless pest in that country.

May 19th I left Colombo for Tuticorin, India; from there by railroad to Madras, Bombay, Nagpur, Poona, Karad, Goa, and Bangalore. Having made myself acquainted with the conditions at all of the above mentioned places in India, I decided to establish my headquarters at Bangalore. I then returned to West Australia, arriving at Perth June 22d. I remained there a month, leaving again July 23d for Bangalore, where I arrived August 12th, and at once began one of the most important and interesting experiments of my whole life.

WILT OF THE BLACK-EYE BEAN.

By R. S. Vaile, County Horticultural Commissioner, Santa Paula, California.

A blight of some economic importance has appeared this season on the black-eye beans, *Vigna catjang* var., in Ventura County. This disease has been reported in limited amounts from two distinct sections of the country. While the damage has not been great, it has been sufficient to attract attention among several of the growers.

The trouble is in the nature of a wilt, caused by the fungus *Fusarium vasinfectum* Atk. Individual plants, after they reach the age of a few

Fig. 287. Black-eye beans showing the effects of the wilt on the stems. (Photograph by H. S. Fawcett.)

weeks, wilt down very suddenly. One field in particular was noted by the writer that gave a very mottled appearance because of the dead vines. Other fields in the same vicinity were found apparently not affected at all.

This is evidently the same disease that attacks the cowpea (*Vigna catjang*) in the Southern States. Stevens and Hall have the following to say regarding this trouble:

"WILT, FUSARIOSE (*Fusarium vasinfectum* Atk.)—The disease is closely related to fusariose of cotton, okra and watermelon, though the disease is not communicable from one of these plants to the other.

"It first appears when the plants are about six weeks old. Up to this time they will grow well and appear healthy. Scattering plants then begin to drop their leaves, the lower ones falling first. Growth is checked and the stem shows a faint reddish brown tinge. After the leaves have fallen the stems die and become covered with a light pink coating of the spores of the wilt fungus.

"In moderate cases, or where the varieties planted are less subject to the disease, only the weaker plants are killed, while the rest are dwarfed and their yield reduced."

Fawcett reports the disease (Ann. Report Fla. Exp. Sta. 1906) as attacking Refugee beans in Florida, and Massee speaks of the same disease as "cotton frenching."

The writer is indebted to Mr. H. S. Fawcett for the identification of the fungus on local plants, as well as for the accompanying cut (Fig. 287), made from specimens gathered by the writer.

CHECK LIST OF CALIFORNIA INSECTS III.

By C. W. Woodworth, Professor of Economic Entomology, University of California, Berkeley, Cal.

LEPIDOPTERA—(Continued).

NYCTEOLIDÆ.

Nycteola revayana Scop.

PERICOPIDÆ.

Gnophaela *hopfferi*—latipennis.
latipennis Boisd.

DIOPTIDÆ.

Phryganidia californica Pack.

NOTODONTIDÆ.

Alastor gibbosa—Nadata.
Cerura cinerea—Harpyia.
cinereoides—Harpyia.
paradoxa—Harpyia cinerea.
scolepandra Harpyia.
Clostera incarcerata—Melalopha apicalis.
Coelodasys conspecta—Schizura unicornis.
Datana californica Riley
ministra Drury.
Dicranura scolopendrina—Harpyia.
Drymonia dimidiata—Pheosia.
Eumelia severa—Gluphisia.
Gluphisia *albofascia* wrightii.
crenata—septentrionalis.
septentrionalis Walk.
severa Edw.
wrightii Edw.
Harpyia cinerea (Walk.).
scolopendrina (Boisd.).
Hyperaeschra strangula (Grote).
Ichthyura apicalis—Melalopha.
bifiria—Melalopha.
brucei—Melalopha.
incarcarata—Melalopha apicalis.
inornata—Melalopha.
ornata—Melalopha apicalis.
Melalopha apicalis Walk.
alethe—brucei.
brucei Edw.
inornata Neum.
multonoma—brucei.
Melia danbyi—Gluphisa severa.
Nadata *behrensii*—gibbosa.
gibbosa (S. & A.).
oregonensis—gibbosa.
Notodonta californica—Pheosia dimidiata.
pacifica—Hyperæschra strangula.
strangula—Hyperæschra.
Oedemasia salacis—Schizura concinna.
unicornis—Schizura.
Phalæna concinna—Schizura.
gibbosa—Nadata.
unicornis—Schizura.
Pheosia *californica*—dimidiata.
dimidiata H. S.
portlandia Edw.
Schizura concinna S. & A.
conspecta—unicornis.
ipomoeæ Doub.
unicornis S. & A.

THYATIRIDÆ.

Bombycia improvisa Edw.
Gluphisia tearlei—Bombycia improvisa.
tearlei—improvisa.

LIPARIDÆ.

Hemerocampa vetusta Boisd.
Orgyia canæ—Hemerocampa vetusta.
gulosa—Hemerocampa vetusta.
vetusta—Hemerocampa.

LASIOCAMPIDÆ.

Clisiocampa americana—Epicnaptera.
californica—Malacosoma.
constricta—Malacosoma fragilis.
disstria—Malacosoma.
drupaceārum—Malacosoma disstria.
Epicnaptera americana Harris.
erosa—Malacosoma disstria.
fragiles—Malacosoma.
thoracia—Malacosoma.
pseudoneustria—Malacosoma californica.
frutetorum (not California).
Gastropacha americana—Epicnaptera.
Lasiocampa carpinifolia—Epicnaptera americana.
Malacosoma *ambismilis*—californica.
californica Pack.
constricta—fragilis.
disstria Hübn.
fragilis Stretch.

BOMBYCIDÆ.

Bombyx mori Linn.

PLATYPTERYGIDÆ.

Drepana arcuata Walk.
siculifer Pack.

GEOMETRIDÆ.

Acidalia ancellata—Cinglis.
californiaria—Eois sideraria.
dataria—Cosymbia.
granitaria—Eois.
magnetoria—Leptomeris.
pacificaria—Eois sideraria.
5 linearia—Leptomeris.
rubrolinearia — Leptomeris magnetaria.
rubromarginaria—Xystrota hepaticaria.
sideraria—Eois.
subalbaria—Eois anticaria.
Aethalodes packardaria (Hulst.).
Aethyctera electa Hulst.
Alcis *californiaria*—imitata.
dejecta Hulst.
depromaria Grote.
imitata Walk.
latifasciaria (Pack.).
metanemaria Hulst.
obliquaria Grote.
sulphuraria Pack.
Alsophila pometaria Harr.
Anagoga pulveraria Linn.
Anaplodes arizonaria Grote.
festaria—arizonaria.
illustraria Hulst.
iridaria Guen.
pistacearia Pack.
Ania brehmeata Gros.
Anisopteryx pometaria—Alsophila.
vernata—Paleacrita.
Annemoria faseolaria (Guen.).
graefiaria Hulst.
Apæcasia mercedulata Strech.
Aplodes rubrifrontaria Pack.
Aspilates *opuscularia*—Pterospoda.
behrensaria—Deilinia.
desperaria Hulst.
dissimilaria Hübn.
Azelina ancetaria Hübn.
behrensata Pack.
occidentalis Hulst.
hubneraria—ancetaria.
Baptria californiata—Euchoeca.
Biston virginarius—Lycia.
Boarmia californica—Alcis imitata.
clivinoria—Selidosema clivinarium.
plumogeraria Hulst.
wrightiaria Hulst.
Brephos californicus Boisd.
melanis Boisd.
Caberodes confusaria Hübn.
Camptogramma fluviata—Percnoptilota.
Caripeta æqualiaria Grote.
Catopyrra ferruginosaria (Pack.).
Cherodes ægrotata—Sabuloides caberata.
nubiliata—Sabuloides.
Chesiadodes morosata Hulst.
Chesias occidentaliata—(synonymy undetermined).
Chlorochlamys chloroleucaria Guen.
phyllinaria Zell.
Chlorochlystis inconspicua Hulst.
Chlorosea *fasciolaria*—Annemoria.
nevadaria Pack.
perviridaria—Annemoria faseolaria.
Choerades nubiliata—Sabuloides.
Cidaria glaucata—Hydriomena sordidata.
leoninata—Eurhinosea.
mancipata—Eurhinosea.
multilineata—Mesoleuca implicata.
nubilata—Sabuloides.
4 punctata—Cœnocalpe magnoliata.
rubrosuffusata—Rheumaptera.
subochreata—Eurhinosea mancipata.
Cinglis ancellate Hulst.
Cleora *atrofasciata*—Siagraphia continuata.
caberata—Sabuloides.

Cleora correllatum Hulst.
formosata Hulst.
punctomacularia—Philedia.
Cœnecalpe annellata Hulst.
carnata Pack.
cœnonymphata Hulst.
magnoliata Guen.
oxygramma Hulst.
phlebeculata (Guen.).
polygrammata Hulst.
Cœnocharis interruptaria Grote.
Coniodes plumigeraria Hulst.
Coremia *californiata*—Petrophora munitata.
convallaria—Petrophora.
defensaria—Petrophora.
phlebeculata—Cœnocalpe.
prepugnata—Gypsochroa designata.
Coryphista badiaria Edw.
meadii Pack.
Cosymbia dataria (Hulst.).
Cymatophora benigna Hulst.
bicolorata Fabr.
bitactata Walk.
californiaria—Platea.
guenearia Pack.
inquinaria Hulst.
occiduaria Pack.
subcessaria Walk.
umbriferata Hulst.
Dasyfidonia avuncularia Pack.
Deilinia behrensaria Hulst.
carnearia Hulst.
falcataria Pack.
fœminaria Guen.
fumosa Hulst.
litaria Hulst.
nevadaria Hulst.
nigroseriata (Pack.).
perpallidaria Grote.
quadraria Grote.
Ectropis crepuscularia D. & G.
Ellopia californiaria—Platea.
placeraria—Pherne.
Enchoria albifasciata Pack.
osculata Hulst.
Enemera juturnaria Guen.
Enypia venata Grote.
Eois anticaria Walk.
granitaria Pack.
lævitaria Hübn.
lanceolata Hulst.
microphysa Hulst.
occidentata—Leptomeris occidentaria.
sideraria Guen.
Epirrita 12 lineata—Venusia.
Ersephila grandipennis Hulst.
indistincta Hulst.
Eubolia custodiata—Hydriomena.
Eucestia rotundata (Pack.).
Euchlæna argillaria (Hulst.).
falcata (Pack.).
johnsonaria Fitch.
Euchœca californiata Pack.
cretaceata Pack.
Eucrostis viridipennata Hulst.
Eucymatogne intestinata Guen.
Eupithecia behrensata—Azelina.
cretaccata—Euchœca.
longipalpata—Mycteropoda.
nevadata—Tephrodistis.
rotundopuncta—Tephrodistis.
subapicata—Tephrodistis.
Eurhinosea flavaria (Pack.).
leoninata (Pack.).
mancipata (Guen.).
Eustroma nubilata Pack.
Eutrapela anafracta—Sabuloides.
falcata—Euchlæna.
nubilata—Sabuloides.
Fidonia avuncularia—Dasyfidonia.
Geometra illustraria—Anaplodes.
iridaria—Anaplodes.
iridaria—Anaplodes illustraria.
rectaria—Anaplodes iridaria.
Glaucina incopriata Hulst.
Glaucopteryx cretaceata—Euchœca.
implicata—Mesoleuca.
magnoliata—Cœnocalpe.
Gonodontis formosa Hulst.
Gorytodes uncanaria—Platea californiaria.
Gymnocelis inferior Hulst.
minuta Hulst.
Gypsochroa designata Hübn.
sitellata Guen.
Halia cineraria—Symphreta marcessaria.
4 linearia—Cymatophora bitactata.
marcessaria—Symphreta.
tripunctaria—Symphreta.
Hemerophila latifasciaria—Alcis.
packardaria—Aethalodes.
Hesperumia ochreata—Alcis sulphuraria.
Heterolocha edwardsata—Neoterpes.
Heterophleps triguttaria Her.
Holochroa dissociaria Hulst.
Hydria undulata Linn.
Hydriomena amorata Hulst.
autumnalis Strom.
banavahrata Strech.
californiata Pack.
costiguttata Hulst.
custodiata (Guen.).
herbicolata Hulst.
indefinata Gros.
latirupta Walk.
neomexicana Hulst.
packardata Gros.
5 fasciata—sordidata.
sordidata Fabr.
sparsimacula Hulst.
speciosata (Pack.).
tæniata Steph.

Hyperitis notataria Hulst.
triangulifera Pack.
Hysepetes californiata—Hydriomena.
5 fasciata—Hydriomena sordidata.
speciosata—Hydriomena.
viridata—Hydriomena sordidata.
Hyria occidentaria—Leptomeris.
Larentia cumatilis—Cœnocalpe magnoliata.
implicata—Mesoleuca.
12 lineata—Venusia.
Leptomeris magnetaria Guenee.
occidentaria (Pack.).
quinquelnearia Pack.
Lithostege rotundata—Eucestia.
Lozogramma fœminaria—Delinia.
juturnaria—Enemera.
nigroseriata—Delinia.
Lycia virginaria (Grote.).
Cacaria *californiaria*—Siagraphia.
sabularia Guen.
s-signata Pack.
Marmarea occidentalis Hulst.
Marmopteryx marmorata Pack.
Melanolophia canadaria (Guen.).
Mesoleuca *californiata*—Hydriomena packardata.
ethela Hulst.
gratulata Walk.
hersiliata Guen.
implicata (Guen.).
truncata Hufn.
vasaliata Guen.
Metanema *argillaria*—Euchæna.
aurantiacaria—Sabuloides.
cervinaria—Sabuloides.
forficularia—Sabuloides caberata.
forficularia—Guen.
inatomaria Guen.
subpunctata Hulst.
Metrocampa prægrandaria Guen.
viridoperlata—prægrandaria.
Mycterophora longipalpata Hulst.
monticola Hulst.
Nenoria faseolaria—Annemoria.
Neoterpes edwardsata (Pack.).
Nepytia nigrovenaria Pack.
umbrosata Pack.
Numeria californica—(synonymy undetermined).
Nycterosea brunneipennis Hulst.
Nyctobia nigroangulata Str.
Ochyria abrasaria—Petrophora.
carneata—Cœnocalpe carnata.
gueneata—Hydriomena custodiata.
lacteata—Trichochlamys.
lignicolorata—Zenophleps.
munitaria—Petrophora.
rubrosuffusata—Rheumaplero.
Odezia californiata—Euchœca.
Opæcasia mercedulata Str.
Orthofidonia elsinora Hulst.
Paleacrita longiciliata Hulst.
vernata (Pack.).
Panagra flavofasciata—Siagraphica neptaria.
subminiata—Siagraphica.
Percnoptilota fluviata (Hübn.).
Petrophora abrasaria H. S.
convallaria Guen.
defensaria Guen.
flavata—Eurhinosea flavaria.
leoninata—Eurhinosea.
mancipata—Eurhinosea.
munitata Hübn.
nemorella Hulst.
prunata—Eustromo nubiliata.
truncata—Mesoleuca.
Phasiana irrorata—Siagraphia.
neptata—Siagraphia neptaria.
subminiata—Siagraphia.
Phengommataea edwardsata Hulst.
Pherne parallelia Pack.
placearia Guen.
Philedia punctomacularia Hulst.
Philereme californiata Pack.
Philobia enotata Guen.
Philopsia nivigerata Walk.
Philtræa elegantaria Edw.
Platea californiaria Her.
diva Hulst.
Pleymria *fulviata*—Percnoptilota.
georgii—Rheumaptera.
Pteropoda opuscularia Hulst.
Pterospoda perumbraria.
Pterotæa cariosa Hulst.
Procherodes catenulata—Sabuloides.
Rachela latipennis Hulst.
Rheumaptera *basaliata*—Hydriomena tæniata.
brunnercillata—Mesoleuca gratulata.
delimiata War.
georgii (Hulst.).
rubrosuffusata (Pack.).
Sabulodes anfractata Hulst.
aurantiacaria Pack.
caberata (Guen.).
catenulata (Grote).
cervinaria (Pack.).
nubilata (Pack.).
truxaliata (Guen.).
Scelidacantha virginata (Graef).
Sciagraphia californiaria Pack.
continuata Walk.
denticulata Grote.
granitata Guen.
irrorata Pack.
muscariata Guen.
neptaria Guen.
sinuata Pack.
spodoplerata Hulst.
subminiata (Pack.).
Scotosia californiata—Philereme.
hæsitata—Triphosa dubitata.

Solidosema *californiata*—Enemera juturnaria.
clivinarium Guen.
correktatum Hulst.
delicatum Hulst.
humarium Guen.
lachrymosum Hulst.
laminarium Streck.
wrightiarum Hulst.
Semiothisa denticulata—Siagraphia.
inquinaria—Cymatophora.
umbriferata—Cymatophora.
Sicya *croceraria* macularia
macularia Harr.
Sigela penumbrata Hulst.
Slossonia rubrotincta Hulst.
Sympherta marcessaria Guen.
tripunctaria Pack.
Synaxis oblentaria Grote.
Synchlora denticulata Walk.
liquoraria Guen.
Synglochis perumbraria Hulst.
Tephina haliata—Sciagraphia granitata.
lorquinaria—Sympherta tripunctaria.
monicaria—Deilinia fœminaria.
muscariata—Sciagraphia.
neptaria—Sciagraphia.
sabularia—Macaria.
unicobraria—Alcis sulphuraria.
Tephroclystis acutipennis Hulst.
annulata Hulst.
behrensata Pack.
bivittata Hulst.
brunneipennis Hulst.
californiata—miserulata.
cestata Hulst.
cretata Hulst.
implorata Hulst.
laisata Streck.
longipalpata Pack.
miserulata Grote.
misturata Hulst.
Tephroclystis nevadata Pack.
nimbicolor Hulst.
nimbosa Hulst.
obscurior Hulst.
ornata Hulst.
raveocostaliata Pack.
rotundopuncta Pack.
subapicata Guen.
unicolor Hulst.
Tephrosia californiara—(synonymy undetermined).
canadaria Melanolophia.
carneoria—Deilinia.
celataria—Deilinia fœminaria.
falcatria—Deilinia.
fautaria—Thallophaga.
ferruginosaria—Catopyrrha.
nevadaria—Deilinia.
nigroscriata—Deilinia.
Tetracis ægrotata—Sabuloides caberata.
aurentiacaria—Sabuloides.
cervinaria—Sabuloides.
edwardsata—Neoterpes.
mellitularia—Pherne placearia.
parallelia—Pherne.
triangulifera ta—Hyperitis.
truxaliata—Sabuloides.
Thallophaga fautaria Hulst.
Thamnonoma guencaria—Cymatophora.
mercessaria—Sympherta.
4-linearia—Cymatophora bitactata.
3-punctaria—Sympherta.
Trichochlamys lacteata (Pack.).
Triphosa badiaria Edw.
dubitata Pack.
pustularia Edw.
Venusia cambrica Curt.
duodecemlineata (Pack.).
virginata—Scelidacantha.
Xanthorhœ nemorella Hulst.
Xystrota hepaticaria Guen.
Zenophlips lignicolorata (Pack.).
obscurata Hulst.

NOLIDÆ.

Celama anfracta Edw.
aphyla Hamp.
minna Bull.
Nola apera Druce.
hyemalis—Celama minna.
minuscula—Roseelia.
Roseelia minuscula Zell.

PSYCHIDÆ.

Chalia fragmentella Edw.
Hyaloscotes fumosa Butl.
Oiketicus davidsoni Edw.
Thyridopteryx meadii Edw.

THYRIDÆ.

Belnoptera fratercula Pag.
Hexeris enhydris Grote.
Dysodia oculatana Clem.
vitrina Boisd.

COSSIDÆ.

Cossus populi Walk.
Hypopta bertholdi Grote.
riversii Stretch.
Prionoxystus robiniæ (Peck.).
Xyleutes robiniæ—Prionoxystus.

SESIIDÆ.

Aegeria *hemizonæ*—Sesia.
impropria—Sesia.
lupini—Sesia.
mandariæ—Sesia rutilans.
noveboracensis—Sesia.
pacifica Edw.
Albuna *artemisiæ*—Sesia mellinipennis.
pyramidalis Walk.
resplendens—Sesia millinipennis.
Melittia gloriosa Edw.
satyriniformis Hübn.
Memythrus robinæ Edw.
Paranthrene heucheræ (Edw.).
Pyrotænia achillæ—Sesia.
behrensii—Sesia.
polygoni—Sesia.
Sanninoidea opalescens Edw.
Sesia achillæ (Edw.).
albicornis Edw.
behrensii (Edw.).
elda—behrensii.
eremocarpi.
helianthi.
meadii.
orthocarpi.
mellinipennis Boisd.
neglecta Edw.
novarœnsis (Edw.).
pictipes G. & R.
polygoni (Edw.).
rileyana Edw.
rutilans Edw.
tipuliformis Clerck.
Trochilium pacificum—Aegeria.
Vespamima sequoiæ Edw.
Zenodoxus heucherœ—Paranthrene.

OCTOBER CROP REPORT.

By G. E. Merrill.

Oranges.

No material change has developed in the orange situation since the issuance of our last report. South of the Tehachapi the crop will be about equal to that of the last year's. In the San Joaquin Valley the crop will likely not be over fifty per cent of normal. In the Sacramento Valley the harvest is already under way, and some early shipments have been made. The Butte County crop is looking well and about eighty-five per cent of a full crop is promised from that district.

Lemons.

There is little change in the lemon situation since the September crop report was issued. An exceptionally fine setting of winter fruit is reported from Ventura County. Los Angeles County reports indicate a crop seventy-five per cent of last year's. Other lemon-growing districts report as good or better prospects. The few hundred lemon trees in Butte County bear a first-class crop. For the State as a whole next year's crop should be at least eighty per cent of last year's.

Olives.

The olive harvest is about to begin. Early reports of an extremely short crop are well supported by those last received. The crop for the State at least promises to be less than half of that of last year's. One olive district does not seem to be favored above another, as the crop is short over nearly all of the State.

GENERAL NOTES.

TENTATIVE PROGRAMME OF THE FORTY-SECOND STATE FRUIT GROWERS' CONVENTION, TO BE HELD AT FRESNO, DECEMBER 11, 12 AND 13, 1912.*

December 11th.

MORNING.

1. Call to order.
2. Welcome.
3. Response.
4. The Control of the Citrus Red Spider_____by W. H. Volck, Watsonville, Cal.
5. Orchard Sanitation_____by H. S. Fawcett, Whittier, Cal.

AFTERNOON.

1. The Grapevine Leafhopper_____by H. J. Quayle, Berkeley, Cal.
2. Prune Culture_____by E. D. Richmond, San José, Cal.
3. Details in Citrus Culture_____by C. C. Chapman, Fullerton, Cal.

EVENING.

Stereopticon Lecture_____by Frederick Maskew, San Francisco.

December 12th.

MORNING.

1. Appointment of Committees.
2. Cultivation and Subsoils_____by A. J. Cook, Sacramento, Cal.
3. Address_____by Dean Thos. F. Hunt, Berkeley, Cal.
4. Address on Soils_____by R. A. Hart, Washington, D. C.

AFTERNOON.

Automobile trip to see county.

EVENING.

Citrus Culture in Foreign Countries (stereopticon lecture)_____
_____by G. Harold Powell, Los Angeles.

December 13th.

MORNING.

1. Drainage and Alkali Reclamation_____by Frank Adams, Berkeley, Cal.
2. Increasing Returns of Muscat Vineyards___by Prof. F. T. Bioletti, Berkeley, Cal.
3. Improvements in Making and Handling Raisins__by Geo. Hecke, Woodland, Cal.; H. P. Stabler, Yuba City, Cal., and Mrs. V. A. Mowatt, Fresno, Cal.

AFTERNOON.

1. Viticulture in Interior Valleys of California_____by F. T. Swett, Martinez, Cal.
2. Coöperation of American Raisin Growers_____by M. N. Nutting, Fresno, Cal.

EVENING.

California's Viticultural Industry: Past and Future (stereopticon lecture)__
_____by H. F. Stoll, San Francisco, Cal.

*Aside from stereopticon lectures, the evenings will be given over to the County Commissioners.

QUARANTINE ORDER NO. 16.

October 15, 1912.

WHEREAS alfalfa fields in the states of Utah, Wyoming, and Idaho are infested with the alfalfa weevil (*Phytonomus posticus*); and

WHEREAS the devastation of this insect is very serious, often ruining the entire crop; and

WHEREAS our alfalfa product is very important, its estimated cash value for the present year being a little short of $50,000,000; and

WHEREAS there is danger of our receiving this pest through the importation of all kinds of hay, including alfalfa from the aforesaid states; and

WHEREAS there is also danger of our receiving this pest through the transportation of colonies of bees in hives from the states aforesaid; therefore,

It is hereby declared that a quarantine be and is hereby established against colonies of bees in hives, all hay, including alfalfa and other hay and straw in cattle cars from the several states before mentioned. All State quarantine guardians and deputies of the State Commissioner of Horticulture are hereby instructed and required to refuse admission into the State of California of all colonies of bees in hives and all hay from the said quarantined states. If such hay is shipped into the State by any oversight, it must at once be destroyed or returned to the shipper, as required by law.

It is hereby further ordered and declared that no alfalfa seed from the infested states shall be received into California except upon compliance with the following conditions: Every lot of alfalfa seed from the infested states must be enclosed in a container sufficiently tight to prevent the egress of any alfalfa weevils, should any be enclosed, and must be shipped either to a quarantine officer of the State of California or to a quarantine guardian or other person authorized in writing by the State Commissioner of Horticulture to receive it; every lot of such seed must be delivered at such freight or express office as shall be designated by said State quarantine officer, quarantine guardian or other authorized person, and held by him in quarantine and sufficiently treated until in his judgment the lot should be released. All expenses incurred in treating for disinfections of such lot of alfalfa seed shall be paid by the consignee or owner, and the alfalfa seed shall not be released until the same is paid.

A. J. COOK,
State Commissioner of Horticulture.

Approved by

A. J. WALLACE,
Acting Governor of the State of California.

CALIFORNIA'S QUARANTINE RECORD.

With the passing of the month of September ends the position that the Quarantine Division of the California State Horticultural Commission has held for many years. Left to its own resources, devices and energies from the very inception, it has built up and maintained a system of inspection and quarantine that so far has proved impregnable. With the 1st of October the Federal Government shares the responsibility of this attempt to protect the horticultural industries of California with those of the United States in general through the operation of "The Plant Quarantine Law." To all of those who have had a share in developing the State Quarantine Service and bringing it up to its present standard of excellence, it is a source of pure gratification to remember that through all of these years, with a paucity of funds, a meagerness of help, absence of popular realization of the true danger, and often the indifference and opposition of those who were paid to know better, we have maintained the fight, kept out the enemy and are in a position to say to the Federal Horticultural Board, with all candor and truthfulness, that there was not a single live specimen of either the Mediterranean, the Mexican, or the melon fly in the State of California when they took up the work of coöperation.

Close observation of the results each day shows clearly that the redistribution of duties put into effect at the San Francisco office on August 1st, justifies the expectations. System, if adhered to, is bound to bring results, and with the multifarious duties contingent upon maintaining a quarantine, order is imperative if the details are to be kept up. The work is going forward with a swing and rhythm that is gratifying to those who are constantly striving for progress. The men like their individual jobs and go at them with a spirit of sincerity which is winning increased interest and coöperation on the part of all those whose duties involve the handling of horticultural imports. The increase in the force has given some standing to the Division, and the presence of an inspector around a ship from a foreign port every day she remains at the dock is a guarantee of watchfulness that is producing a universal respect for the quarantine law. Interest breeds interest,—the Federal customs, always active in this matter, are with us as never before. From Stratton, the collector of the port, down through all grades of his subordinates, officers and men, we have daily assurance that they understand the task we have in hand, and, better still, ample proof that they are diligently coöperating with us. There is a working understanding between this office and the executive heads of the transportation companies that is probably in advance of what has existed on this point in past times, and it is yielding the very best of results. We have found a public prosecutor that likes his job; an army officer who will not stand for a violation of his own general orders; and it seems apparent that if we can maintain the pace we have set it will not be long before a current phrase will be justified and everybody will be trying to enforce the State quarantine law.

FREDERICK MASKEW.

ARIZONA HORTICULTURAL QUARANTINE ORDERS.

QUARANTINE ORDER NO. 1.

Alfalfa Weevil.

In order to restrict the chances of introducing the alfalfa weevil (*Phytonomus posticus*) into Arizona, it is hereby ordered:

(*a*) That the importation into the State of Arizona of hay, straw, grain, alfalfa seed or fruit produced in or shipped from sections or localities infested by this pest, when officially reported as thus infested by state or government entomologists or inspectors, is hereby prohibited and all persons, firms, or corporations in the State are prohibited from having in their possession any herein mentioned article or material produced in such infested sections or localities.

(*b*) That shipments of nursery stock or of household or emigrants' goods originating in any section or locality designated as infested by the alfalfa weevil shall not be brought into the State of Arizona by any common carrier, person or persons unless such shipments be accompanied by a sworn statement, in duplicate, by an official state or government entomologist or inspector after the following form, one copy to be mailed to the State Entomologist, Phoenix, Arizona, and one to be attached to the shipment or to the way bill:

State of_____
County of_____ } ss.

I hereby solemnly swear that I was present during the preparation for shipment of the nursery stock or household goods which this affidavit accompanies; that this preparation was on the _____day of _____, 19__, at_____ (place); that no hay or straw was included in this shipment; that I have thoroughly examined the entire contents of the shipment, including the packing material and believe that no alfalfa weevils are harbored therein, and that this shipment was delivered and accepted for transportation by the _____ (common carrier) on the_____day of _____, 19__, consigned to _____(consignee), at _____ (place).

_____
_____(official title.)

Subscribed and sworn to before me, _____, a notary public in and for the State of _____, county of _____, this _____ day of _____, 19__.

My commission expires _____, 19__. _____, Notary Public.

(*c*) That no shipments of live stock from sections or localities designated as infested shall be brought into Arizona except under special arrangements whereby under the direct observation of an Arizona Crop Pest Inspector such live stock is transferred at some point at or near the Arizona state boundary from the original car to another car with a new supply of litter and feed for use from such point of transfer to destination within the State of Arizona; all being subject to prearrangement with the State Entomologist of Arizona and to the direct approval of the Crop Pest Inspector as to the car, litter, feed, and other details.

(*d*) That shipments of all kinds from sections and localities designated as infested by the alfalfa weevil, except such materials as are pro-

hibited, shall be held for inspection and release by local Crop Pest Inspectors under the provisions of section 8 of the Crop Pest Law of 1912.

(*e*) That in accordance with the lastest official reports the following territory is hereby designated as infested by the alfalfa weevil at the present time: The State of Utah, the counties of Uinta in the State of Wyoming, and Bear Lake in the State of Idaho.

(*f*) That the foregoing designation under section "*e*" of this order may be amended from time to time by the State Entomologist as the future spread and discovery of the alfalfa weevil in new localities may necessitate.

QUARANTINE ORDER NO. 2.

White Flies.

In order to prevent the introduction into the State of Arizona of the three important citrus-infesting species of white flies (*Aleyrodes citri, A. nubifera* and *A. howardi*) it is hereby ordered:

(*a*) That the introduction into the State of Arizona of all citrus (*Citrus* sps.), cape jessamine (*Gardenia jasminiodes*), privets (*Ligustrum* sps.) and rubber (*Ficus indica*) trees or plants from North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Yuba County (California), Cuba, Japan, China, India, and Chile, by any person, persons, firm, or common carrier, is prohibited; provided, however, that citrus seed and bud wood without foliage may be imported from any of these countries, states or counties when such shipments are directed to and after inspection received through the office of the State Entomologist, Phoenix, Arizona.

(*b*) That all persons, firms or corporations in the State of Arizona are prohibited from having possession of, transporting, selling or giving away any of the above mentioned white fly food plants brought into the State in violation of this order.

QUARANTINE ORDER NO. 3.

Mexican Orange Maggot.

In order to prevent the introduction of the Mexican Orange Maggot (*Anastrepha ludens*) into the State of Arizona, it is hereby ordered:

(*a*) That all persons in the State of Arizona are prohibited from having in their possession, transporting or offering for sale any guavas, mangoes or oranges grown in the Republic of Mexico or brought into Arizona from the Republic of Mexico.

(*b*) That all fruit of the kinds designated found by any Arizona Crop Pest Inspector shall immediately be taken in charge by said Inspector and kept in such manner as to eliminate danger of the escape of this orange pest and within twenty-four hours said fruit shall be destroyed or shipped out of the State of Arizona at the option of the owner or owners and at his or their expense.

NOTES FROM THE COUNTY COMMISSIONERS.

By G. E. Merrill.

Inyo County.

Commissioner Baird was chairman of the committee in charge of the Agricultural-Horticultural exhibit at the Harvest Festival recently held at Bishop.

Humboldt County.

Humboldt County is to be congratulated on the excellence of its exhibit at the Watsonville Apple Show. The exhibit was in charge of Commissioner Weatherby, and to it was awarded the second prize in the feature exhibit competition, the first prize going to an exhibit of the Watsonville High School.

Los Angeles County.

The Los Angeles County Horticultural Commission is shortly to publish a bulletin on the important insect pests and plant diseases of that county.

Monterey County.

Commissioner Hickman has recently completed an orchard survey of his county. The present status of horticulture for Monterey County is the result of extensive plantings and consequent dying out of fruits not adapted for the conditions under which they were tried and the later extensive development of fruits that at first did not promise well financially or otherwise.

San Benito County.

Commissioner Day is engaged in making an accurate count of the number of bearing and non-bearing fruit trees in his county.

Santa Clara County.

Commissioner Morris has acquainted us with some peculiarly distorted Clairgeau pears. Some of the specimens are very badly misshapen and abnormally small in size; outside the worst affected fruits appear like badly curculio-stung apples, within the appearance is somewhat like that of apples affected with Baldwin spot disease, except that in the case of the pears the discolorations extend wholly through the body of the fruit. Just what the cause of the trouble is does not appear, and it may be either fungoid or physiological or due to the ravages of some insect. The infection is by no means general, as but two or three trees are badly affected, with several others injured to a small extent.

San Diego County.

A carload of potatoes from Los Angeles County that were infested with eel worm and potato tuber moth was recently rejected by Commissioner Stuart.

A TRIBUTE TO MR. LINDEN BREE.

About a year ago there came into the office of the commission of horticulture a slightly built gentleman who seemed very much interested in horticulture. I was much pleased with our conference. He seemed not only very intelligent but also alert to know all that might be learned regarding fruit culture and allied occupations. I was not surprised to learn afterwards that he had been a student at Cambridge and had gone nearly through the University. Later I was called to Nevada County to hold an examination for county horticultural commissioner, and this gentleman appeared with five others. During the examination one of the supervisors came into the room, and I asked him about this gentleman and learned that he was one of the best ranchers in the county; that his place was not only thoroughly well cultivated, but that for neatness and order it was a model. Later, I was not surprised when on looking over the papers, we found that he had passed with a record that I think has never been surpassed. It was, therefore, with great pleasure that I learned that he had been appointed by the supervisors as horticultural commissioner of Nevada County. This man was Linden Bree.

After taking office he commenced very energetically to make his county a clean one. So great was his intelligence and energy that he so won the support of his supervisors and people that he was backed in perhaps as aggressive a warfare as has ever been commenced in any county of the State.

It was with great sadness of heart that I learned a few days ago that Mr. Bree had gone to the great beyond. I regard this as a very serious loss to our State. Men of high character, splendid performance and alertness of duty and conscience are none too common, and we had reason to expect splendid accomplishment from his office. He had already won the respect and admiration of all who had kept close record of his work.

Mr. Bree was yet a young man, and it is hard to be reconciled to this great loss. I am sure that all who knew him will unite with me in extending to the mother, sister and brother our heartfelt condolence.

A. J. Cook,
State Commissioner of Horticulture.

A FEW FACTS CONCERNING THE FRUIT FLIES OF THE WORLD. IV.

By George Compere.

Indian Parasites of the Fruit Flies.

As previously stated, I arrived at Bangalore, India, August 12, 1907, where the local conditions of the various fruits were studied in order to ascertain those most susceptible to the attacks of the fruit flies. At that time the local fruit season was at its height, all varieties grown in that section of India being well represented in the local fruit market at Bangalore. At the rate the natives were gathering it I could see that by the time I should require fruit on which to propagate fruit fly maggots there would be little or none left.

Upon visiting the various gardens where fruit was grown it was noticed that the guava (*Psidium guayaba*) was or seemed to be the favorite host fruit of many species of fruit flies. From information furnished by some of the native farmers, the guavas could be kept longer on the trees than any other of the local fruits for the reason that they have a succession of crops, and while the first fruits of the season would be ripe there would yet be plenty of younger fruits on the same trees in all stages of development.

August 16th I purchased from a native grower the entire guava crop of his little orchard, which consisted of 14 large trees, and two days later from another native the entire guava crop of 62 large trees. These large guava trees stood from 20 to 40 feet in height, and it was estimated that the crop would average about two bushels per tree. It was agreed that no fruit was to be picked or removed from the places except by myself or by my orders. It must be remembered by the readers that there would be no fruit fly maggots in West Australia before the second or third week in December, and at the time of the purchase of the guava fruits at Bangalore it was only the middle of August, so there were four months that would have to be bridged over, for by the middle of November there would, under ordinary conditions, be no fruits remaining on the trees in India. A few days after the purchase of the fruit on these guava trees an entirely new and unexpected problem in connection with the keeping of the guava fruit manifested itself, for monkeys began to steal the fruit in a way that meant entire loss. In order to prevent this it was necessary to employ a man to keep them out.

Having secured the guava orchards, and arranged to protect them, every garden, orchard or place where fruit was grown about Bangalore and nearby villages was visited, as far at times as Mysore. Maggot-infested fruits of all sorts were collected. These infested fruits were placed in the guava orchards, there being as a rule from one to three men helping me. My object in doing this was to bring together as many of the fruit fly parasites as possible, which also brought together a

number of species of fruit flies. On September 12th I secured a very large zinc-lined dry goods case, filled it half full of ice and began to collect parasitized fruit fly pupæ and place them in tin boxes with damp sand and to seal them up, and every morning during the balance of my stay in Bangalore I would place from 14 to 50 pounds of ice in the box. The keeping of the fruit fly pupæ in a crude ice box was an experiment on my part; it was impossible to keep anything like an even temperature, but was the best that could be done as there was no cold storage plant in the town, all ice coming from the city of Madras.

November 19th I left Bangalore for West Australia. The box containing the ice and parasitized fruit fly pupæ was a very awkward package to travel around with, owing to the fact that it weighed over one thousand pounds. It was fully realized, before leaving Bangalore, that a small amount of ice would last only a few hours in the terrific

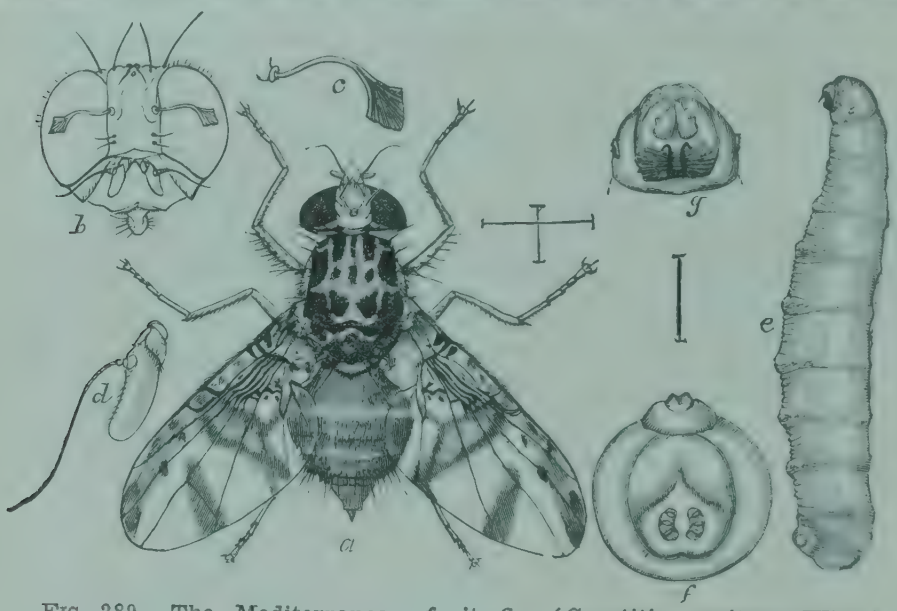

FIG. 289.—The Mediterranean fruit fly (*Ceratitis capitata* Wied.). *a*, adult female fly; *b*, front view of head of male; *c*, spatula-like hair of male shown in *b*; *d*, antenna; *e*, larva; *f*, anal extremity of same; *g*, head of same. Enlarged. (After Insect Life.)

heat of that country, also that the amount I was able to place in the box would not be sufficient to last until I reached Colombo. Therefore, a telegram was sent to Madras, the day before we left Bangalore, for a fresh supply of ice, which met me at Trichinopoly Junction, and with this I was able to reach Colombo with the parasitized fruit fly material in good condition on the morning of November 23d, where I made application to the collector of customs for permission to allow my ice box to remain in the customs shed on the wharf until such time as a steamer bound for Australia would arrive. Twice each day the ice was replenished, this being continued until November 27th, when the German mail steamer *Gneisenau* arrived, bound for Australia. In the cool chambers on board this vessel were placed all the packages containing the parasitized fruit fly material, but before doing so each package was

sewed up in cloth. We arrived at Perth, West Australia, December 7th. All the fruit fly pupæ were at once placed in secure breeding cages, the number parasitized being roughly estimated at from 70,000 to 100,000. Four days later, December 11th, the first parasites began to issue. The fruit season was a little later that year than usual, but a few fruits infested with the larvæ of *Ceratitis capitata* were secured and placed in a breeding cage in which were liberated some of the parasites. These at once began to attack the larvæ of *Ceratitis capitata*. Each day from the 11th of December for more than a month there would issue thousands upon thousands of the parasites. Of one species as many as thirty-six parasites were counted emerging from a single fly pupa, and the average amounted to twenty parasites to each. It was estimated when all the parasites had issued from the Indian material that two million parasites of one species alone had emerged. Of two other

FIG. 290.—George Compere collecting fruit fly parasites in India.

species, there emerged from the Indian material about three hundred parasites all told and only a single parasite from each pupa. From the vast amount of fruit fly pupæ which I had brought from India, there issued only six specimens of the Indian fruit flies, which were at once killed.

The first parasites which had issued from the Indian material was a small black species, which could at a first glance be easily mistaken for small black ants. These would enter the fruits, no matter how badly decayed they might be, and search all through the rotten pulp for maggots, and whenever they located a maggot would at once attack it and deposit as many as three dozen eggs in a single one. Maggots attacked by these little parasites became very uneasy and in most cases would at once leave the fruit presumably to escape the attacks of the

parasites. In such cases the parasite would yet be attached to the maggots when the latter emerged from the fruit. Their coming to the surface attached to the maggots as they do is very likely a provision of nature by which their prey is made to rescue them from the rotten mass of pulp. After coming out of the pulp the parasites will at once clean themselves and again enter the fruit in search of more maggots. Large numbers of these little parasites perish inside the rotten fruit.

The method of operation on the fruit fly maggots by the two species of Braconid parasites was entirely different, as will be noticed by referring to the *Journal of Agriculture* of West Australia, January, 1908. These parasites attack the fly larvæ through the skin of the fruit from the outside. A fruit may appear to be perfectly sound when the parasites will be noticed inserting their ovipositors through the skin into the maggots within, depositing only a single egg in a maggot.

On January 7, 1908, the first lot of West Australian-bred parasites emerged, and from that time on during the whole fruit season hundreds of thousands of the parasites were liberated in the infested orchards and gardens. This clearly demonstrated that the Indian fruit fly parasites would also attack *Ceratitis capitata*, and also that such obstacles as an opposite season would no longer stand in the way of introducing fruit fly parasites into West Australia.

CHILOCORUS SIMILI ROSSI AND ITS RELATION TO SCALE INSECTS IN JAPAN.

By S. NAKAYAMA, Stanford University.

Introduction.

I heard in my boyhood that an American entomologist had imported from the Orient and was breeding the ladybird beetle which feeds on the San José scale and its allies. Japanese call this ladybird *Hime-akahoshi-fentemuski*, or the red-spotted little ladybird, which is scientifically known as *Chilocorus simili* Rossi. In Japan this ladybird is extremely beneficial, because it feeds on nearly all of the scale insects which are injurious to garden and orchard trees growing in that country. I became interested in this ladybird in 1904 and 1905, and was admitted to make an investigation on *Chilocorus simili* Rossi under the direction of Mr. S. I. Kuwana at the Imperial Agricultural Experiment Station, Tokyo, although I was really too young to undertake this kind of work at that time. Some time ago Mr. Kuwana, the entomologist of the same station, reported on part of this work in Japanese in Station Bulletin No. 36.

It is our duty, I think, to work out either beneficial or injurious insects of Oriental nativity and then to report the result to other countries. Having made no report myself, and no one else having taken up the further study of this ladybird since I left Japan, Mr. Kuwana advised me to write a paper on *Chilocorus simili* Rossi for an American

monthly bulletin, even though my work is not completed in regard to the generative power of this little beetle, which shows a marked difference from that of Dr. Marlatt's report. I have used the Station Bulletin No. 36 and the letter of Mr. Kuwana in compiling this present paper, as I left all my notes and other necessary things at the experiment station in Japan. I have also borrowed the figures of Mr. Kuwana to use here. I wish to express my sincere thanks to my professor, V. L. Kellogg, for reading and correcting this paper and also offering various suggestions and criticisms.

Appearance of the Ladybird.

Adult (Fig. 291 A): The head, prothorax and horny sheath or wing covers shiny black. The latter flattened at the edges and with a pinkish-red spot in the middle of each; legs black throughout; length of body, 1–1.5 mm.

Egg (Fig. 291 B): Oval in shape; both ends pointed; presents a light yellow color when first deposited, turning pinkish-red in three or four days and dark gray in a week, changing again to light gray before hatching; length, 0.4 mm.

Larva (Fig. 291 C): About 0.5 mm. at its first hatching and with six rows of black spines on the dorsal side of body. The color of a full-grown larva is brownish-gray; length, 1.5 mm.

Pupa (Fig. 291 D): The ventral and lateral sides of the pupa are covered by the last moulting skin of larva. The dorsum is dark brown in color, often with yellowish cross lines and with a pair of small spines in the middle.

Life History.

Chilocorus similis Rossi has two generations each year. The larva moults three times before pupation. The ladybird passes the winter in the adult stage, hiding under the dead leaves or in the cracks of the bark. The following life history was worked out in one of my breeding cages:

First generation:

April	4	Placed the wintering adult beetles in the cage.
April	7	Eggs deposited.
May	5	Eggs hatched.
May	11	First moulting of larvæ.
May	16	Second moulting of larvæ.
May	23	Third moulting of larvæ.
June	3	Larvæ pupated.
June	14	Adults emerged.

Second generation:

June	17	Adults deposited eggs.
July	15	Eggs hatched.
July	21	First moulting of larvæ.
July	26	Second moulting of larvæ.
August	1	Third moulting of larvæ.
August	12	Larvæ pupated.
August	22	Adults emerged and hibernated during the winter.

Food of the Ladybird.

The principal food of this beetle consists of scale insects, and especially the young. It very seldom feeds on aphids. This little ladybird feeds on the following *Coccida* in Japan: *Aspidiotus perniciosus* Comst.; *Pseudaonidia duplex* Ckll.; P *paeonia* Ckll.; *Aulacaspis pentagona* Targ. and *Parlatoria proteus* Cart.

Among those scale insects mentioned above, the beetle prefers first *Aulacaspis pentagona* Targ., and then *Aspidiotus perniciosus* Comst.

The Rate of Food-taking.

In the breeding cage a larva hatched about noontime began to take its first meal at nine o'clock the next morning. The larva has but a

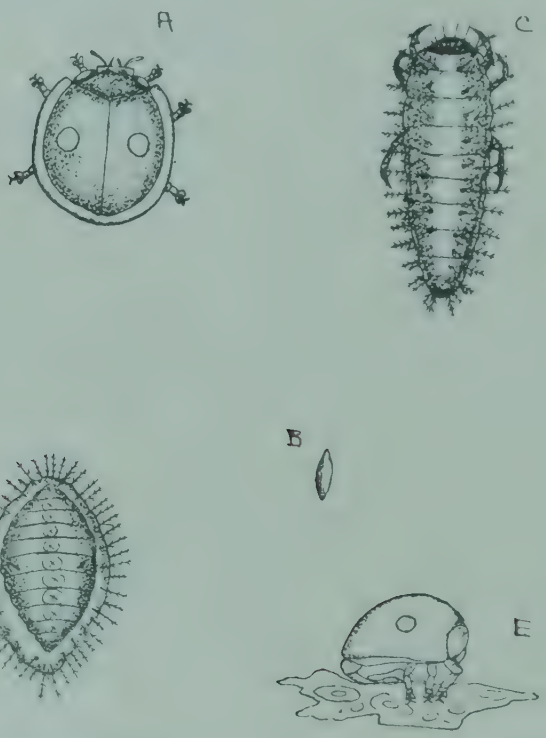

FIG. 291.—*Chilocorus simili* Rossi. *A*, adult; *B*, egg; *C*, larva; *D*, pupa; *E*, adult female laying an egg under the scale. Drawn from nature and all enlarged. (After Kuwana.)

small appetite in the first stage and eats on an average but one or two young scale insects. In the middle of the fourth stage, however, it eats more than fifty scales a day. Most of the larvæ eat from seven to eight hundred scales in the total larval period, while an adult ladybird eats from eight to nine hundred, averaging from twenty to forty scales daily. The adult lives for about thirty-five or thirty-six days. The food-taking process is shown in detail in the following lists:

Food-taking list of larvæ of the ladybird.

	Date.	No. 1.	No. 2.	No. 3.	No. 4.	Notes.
First stage	May 6	2	1	1	3	
	May 7	3	2	3	4	
	May 8	7	8	6	9	
	May 9	11	10	13	11	
	May 10	14	13	15	17	
	May 11	19	16	18	15	
	May 12	18	17	17	12	First moulting
Second stage	May 13	21	11	22	23	
	May 14	27	30	27	25	
	May 15	24	32	35	33	
	May 16	26	29	32	34	
	May 17	28	27	29	26	
	May 18	27	21	23	20	Second moulting
Third stage	May 19	34	25	17	13	
	May 20	32	31	22	23	
	May 21	28	29	25	36	
	May 22	49	52	43	40	
	May 23	38	46	39	48	
	May 24	39	42	41	47	Third moulting
Fourth stage	May 25	33	40	36	45	
	May 26	42	43	44	48	
	May 27	41	39	49	51	
	May 28	50	46	52	54	
	May 29	47	42	45	53	
	May 30	34	38	32	31	
	May 31	20	24	26	28	
	May 1	18	19	15	14	
	May 2	19	11	13	22	
	May 3	11	8	9	17	
	May 4	5	0	4	3	
	May 5	pupated	0	2	pupated	
	May 6			pupated		
	Total	775	752	758	805	

Food-taking list of adults of the ladybird.

Date.	No. 1.	No. 2.	No. 3.	No. 4.
June 16	22	3	21	13
June 17	23	13	33	12
June 18	30	29	35	27
June 19	21	14	18	12
June 20	38	40	32	33
June 21	24	31	28	29
June 22	21	25	29	18
June 23	15	27	23	26
June 24	28	24	35	39
June 25	31	30	34	33
June 26	36	31	39	8
June 27	28	35	41	27
June 28	31	20	36	18
June 29	36	32	33	35
June 30	28	37	38	36
July 1	33	31	39	40
July 2	38	32	43	41
July 3	44	28	34	45
July 4	38	19	16	28
July 5	22	23	17	27
July 6	16	23	24	21
July 7	14	18	19	died
July 8	13	17	11	
July 9	29	26	23	
July 10	25	21	22	
July 11	28	13	17	
July 12	34	29	24	
July 13	32	31	27	
July 14	37	39	32	
July 15	26	27	25	
July 16	15	18	21	
July 17	13	17	16	
July 18	9	11	12	
July 19	7	5	8	
July 20	3	died	7	
July 21	died		died	
Totals	886	819	902	558

(For the food of these experiments *Aulacaspis pentagona* Targ. was used.)

The Feeding Habits.

Both larva and adult of this ladybird bite and chew the young of scale insects. The former first makes a hole in the scale and then pulls the body out through the hole or pushes the head into it. The adult, however, very commonly lifts the scale up with the mouth, and pulls the body out. The ladybird eats a young scale insect in a second, while it requires from twenty to twenty-five minutes to devour a fully developed body.

The Egg-laying Habits.

The female ladybird has the habit of laying her eggs under the scale, usually depositing one under each scale, but often I have found two and sometimes three. The eggs are also deposited under the bark or between cracks wherever a suitable place is found. The method of depositing the egg under the scale is shown in Fig. 291E. It requires from twenty to thirty minutes to deposit a single egg. In regard to determining the number of eggs laid by the mother, I met several difficulties in keeping the fixed temperature in the breeding room, owing to the bad season of the year. The following list gives the numbers of eggs deposited by four females during their adult stages:

Date.	No. 1.	No. 2.	No. 3.	No. 4.
April 7	1	1	0	1
April 8	1	2	1	1
April 9	2	1	3	1
April 10	1	0	1	0
April 11	0	1	1	2
April 12	4	1	1	1
April 13	1	1	1	1
April 14	1	1	1	1
April 15	0	0	2	3
April 16	2	3	1	1
April 17	1	1	0	1
April 18	1	1	1	1
April 19	0	0	0	0
April 20	0	0	0	0
April 21	2	0	1	2
April 22	1	1	1	1
April 23	0	0	0	0
April 24	0	0	0	0
April 25	0	0	0	0
April 26	0	0	0	0
April 27	0	died	0	0
April 28	0		0	0
April 29	0		0	0
April 30	0		0	0
May 1	died		1	died
May 2			0	
May 3			died	
Totals	18	14	16	17

In one experiment I determined that a single female is able to deposit from sixteen to seventeen eggs even under very unfavorable conditions.

CITRUS GALLS.

By H. S. Fawcett.

Abnormal growths somewhat resembling crown galls have been found on branches of both lemon and orange trees in this State. As far as known, this type of gall has not heretofore been reported on citrus.

Though these galls seem to be only of rare occurrence and cannot as yet be considered of any great economic importance, it may be of value to have them illustrated and described. The attention of the writer was first called to these galls by Mr. J. A. Prizer of San Diego County,

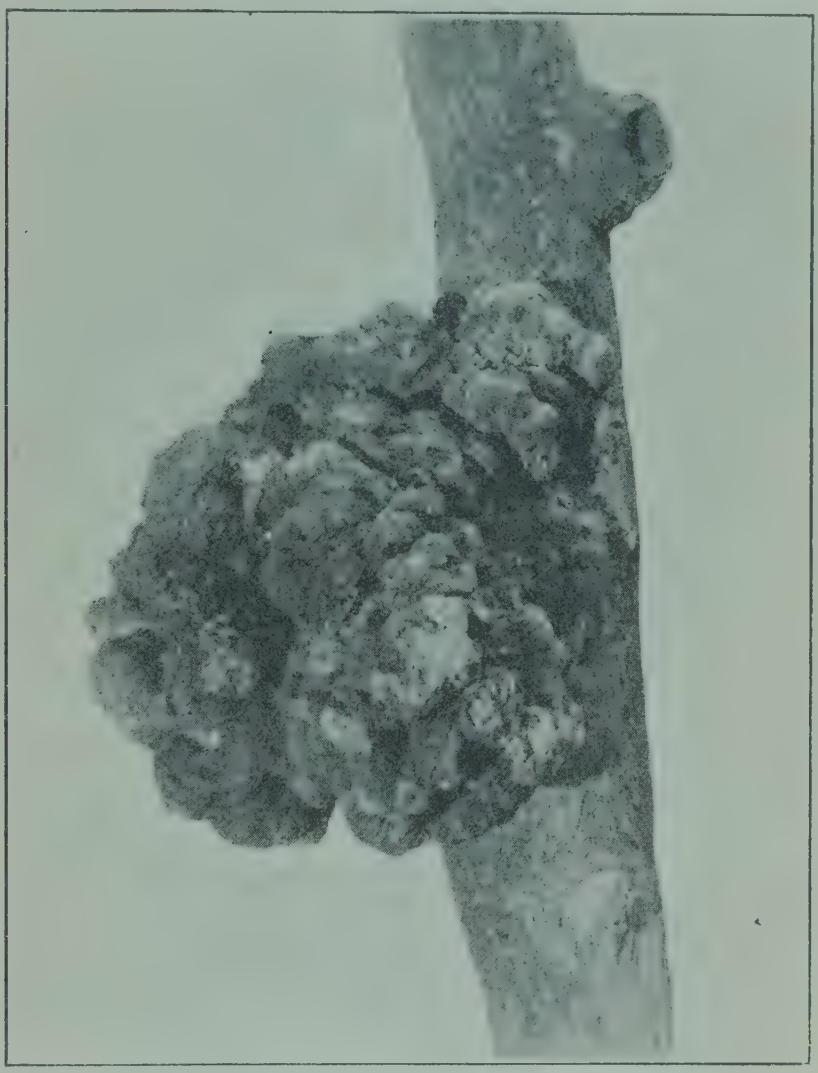

Fig. 292.—Gall on lemon branch, about one and one half times natural size. (Original.)

in February. The pruners had brought in a few of them on lemon branches, one of which is shown in Fig. 292. A few weeks later a similar gall, four or five inches in diameter, on an orange limb, was sent in from Butte County by Mr. Earl Mills. (Fig. 293.) Smaller galls

of the same general type on younger branches were recently sent in from San Diego County by Mr. Prizer. (Fig. 295.) As the appearance of the galls is fairly well shown in the illustrations, only a brief description is necessary. They all appear to have started from one definite point on the side of a limb, and to have been formed by the development of spongy or woody tissue. The one on the young branch (Fig. 294 C) has a somewhat smooth surface and probably represents

FIG. 293. Gall on orange branch, about two thirds natural size. (Original.)

an early stage of formation. In Fig. 294 B the surface is cracked and broken, showing irregular depressions and elevations much like a typical crown gall of peach. The other illustrations show irregularities of surface more pronounced.

Fig. 295 was found high up in a lemon tree at the branching of a large limb. On the opposite side from that shown in the picture it had a large dead cracked portion that was in appearance quite similar to

the condition of old weathered galls so often seen at the base of deciduous fruit trees.

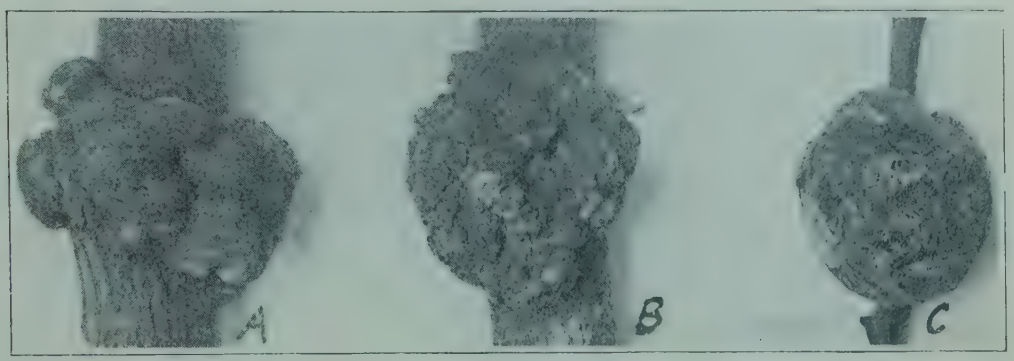

FIG. 294.—Galls on lemon branches, natural size. (Photograph by C. O. Smith.)

It is of considerable interest that previous to the finding of these galls on citrus, Mr. C. O. Smith, of the Whittier Laboratory, had produced on lemon and orange branches small galls of this same general type by

FIG. 295.—Gall on lemon branch, two thirds natural size. (Original.)

inoculation with the organism, *Bacterium tumefaciens*, known to be the cause of crown gall of peach and other plants. Mr. Smith is now

making cultures from some of the galls found naturally on lemon and orange branches to determine definitely, if possible, whether or not the citrus galls are due to the same cause as the crown gall of peach and other plants.

It may be of interest also to mention here that an abnormal growth of a different kind, known as "Lime and Orange Knot,"* has been reported in Jamaica. This knot in Jamaica is due to a fungus, *Sphæropsis tumefaciens*. The writer, when in Florida, was able to produce this Jamaica type of knot on lemon branches from cultures obtained from Jamaica specimens. Culture tests made from the California galls have failed to show this fungus present.

As this crown gall-like growth is not likely to cause any serious damage to citrus in the State, no remedy need be mentioned except to prune them out.

The writer would be glad to receive for examination any such growths found on citrus trees.

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* Hedges, Florence. The Cause of the Lime and Orange Knot. Phytopathology, I, p. 63.

CHECK LIST OF CALIFORNIA INSECTS IV.

By C. W. Woodworth, Professor of Economic Entomology, University of California, Berkeley, Cal.

LEPIDOPTERA (Continued).

PYRALIDÆ.

Aedis funalis—Evergrestis.
Achroa grisella Fabr.
Acrobasis alatella—Myelois.
tricolorella—Mineola.
Aglossa cuprealis Hübn.
Ambesa walsinghami Rag.
Annaphila immerens—Titanio.
Anerastia excantalis—Megaspis.
Anoristia olivella Hulst.
Aphomia sociella Linn.
Argyria auratella (Clem.).
Attacapa callipeplella Hulst.
Autocosmia nexalis Hulst.
Bandera subluteella Rag.
Botis annaphilalis—Loxostege.
californicalis—Pyrausta rubricalis.
catenulalis—Pyrausta mustelinalis.
commortalis—Pyrausta.
dapalis—Titanio.
fodinalis—Pyrausta.
fumoferalis—Pyrausta.
lethalis—Pyrausta.
levalis—Pilocris inguinalis.
lulualis—Loxostege anartalis.
monulalis—Pyrausta mustelinalis.
mustelinalis—Pyrausta.
nasonialis—Loxostege.
nexalis—Autocosmia.
obnigralis—Pyrausta unifascialis.
octosignatus—Pyrausta.
offumalis—Loxostege.
perrubralis—Pyrausta.
profundalis—Phlyctænia.
semirubralis—Pyrausta.
thrallophilalis—Loxostege.
unifascialis—Pyrausta.
uxorculalis—Pyrausta nicalis.
vacunalis—Pyrausta.
Calamochrous straminea War.
Cayuga *bistriatella*—gemmatella.
gemmatella (Hulst.).
Chalcœla gemmalis Hulst.
Chilo leachellus—Crambus.
Cœnochroa californiella Rag.
Crambus albilineellus Fern.
anceps Grote.
attenuatus Grote.
auratellus—Argyria.
behrensellus—biothanatilis.
biothanatalis Hulst.
gausaplis Hulst.
hastiferellus Walk.
hortuellus (Hübn.).
leachellus (Zin.).
luteolellus Clem.
occidentalis Grote.
pascuellus (Linn.).
perlellus (Scop.).
pusionellus Zell.
toparius—hortuellus.
ulæ—luteolellus.
undatus Grote.
unistriatellus Pack.
vulgivagellus Clem.
Cybalomia extorris Led.
Dakruma coccidivora—Lætilia.
Dasypyga alternosquamella Rag.
Diaphania hyalinata Linn.
Diasemia elegantalis War.
Diastictis cæcalis.
Diastictis cæcalis War.
Dicymolomia metalliferalis Pack.
Dioryctria calrioralis Walk.
Dolichorhinia aureofasciella Rag.
Eccopsia serratilineella Rag.
Elasmopalpus decoralis Walk.
Emprepes nuchalis—Noctuelia.
Ephestia *albocostalis*—Epischnia.
knehniella Zell.
nigrella Hulst.
opalescella Hulst.
Ephestiodes erythrella Rag.
gilvescentella Rag.
nigrella Hulst.
Epischnia albocostalis (Hulst.).
boideuvaliella Guen.
fulvirugella Rag.
granitella Rag.
ruderella Rag.
Etiella schisticolor Zell.
zinckenella (Treit).
Euchromius ocella—Ommatopteryx.
Eurycreon anartalis—Loxostege.
Eurythmia coloradella Hulst.
Eustixia octonalis Zell.
Euzophera semifuneralis (Hulst.).
Evergestis funalis Grote.
napæalis Hulst.
rimosalis Guen.
straminalis Hübn.
Galleria mellonella Linn.
Glyptoteles rhypodella—Nephopteryx.
Herculia olinalis Guen.
Homœosoma albiscentellum Rag.
impressale Hulst.
mucidellum Rag.
opalescellum Hulst.
Honora *canacostella*—montinatatella.
mellinella Grote.
montinatatella Hulst.
oblitella Clam.
ochrimaculella—mellinella.
scinrella Rag.
undulatella—oblitella.

PYRALIDÆ *Continued.*

Hornigia lugubrella—Moodna.
Lætilia coccidivora (Coms.).
Lineodes integra Zell.
Liopasia teneralis Led.
Lipographis fenestrella (Pack.).
humilis Rag.
leoninella—fenestrella.
Loxostege anartalis Grote.
annaphilalis Grote.
chortalis Grote.
flavalis Fern.
flavifimbrialis Warren.
linealis Fern.
napæalis—Evergestis.
nasonialis Zell.
oberthuralis Fern.
offumalis Hulst.
similalis Guen.
sticticalis Linn.
thallophilalis Hulst.
triumphalis Grote.
Lygropia rivulalis Ham.
Manhatta lugubrella—Moodna.
Megaphysis edwardsialis—Megasis.
Megasis cinctella Hulst.
edwardsialis (Hulst.).
excantalis (Hulst.).
Metasia argalis Fern.
quadristrigalis Fern.
Mineola caliginella (Hulst.).
tricolorella (Grote).
Monocona rubralis War.
Moodna lugubrella (Rag.).
Myelois alatella (Hulst.).
corniella Rag.
grossipunctella Rag.
Nephopteryx *caliginella*—Mineola.
crassifasciella Rag.
fasciolalis (Hulst.).
fenestrella Lipographa.
geminipunctella—ovalis.
leoninella—Lipographis fenestrella.
oblitella—Honora.
ovalis (Pack.).
perfuscalis—Sarata.
rhypodella (Hulst.).
scintillans—Pyla.
semifuneralis—Euzophera.
subtinctella Rag.
undulatella—Honora oblitella.
Noctuelia nuchalis Grote.
simplex War.
Nomophila noctuella D. & S.
Ommatopteryx ocella (Haw.).
Omphalocera dentosa Grote.
Orobæna octonalis—Eustixia.
Ortholepsis jugosella Rag.
Pachyzancla periusalis Walk.
Palparia ocella—Ommatopteryx.
Parædis napælis Hulst.
Passadena constantella Hulst.
Pempelia albipennella—Standingeria.
fenestrella—Lipographis.
leoninella—Lipographis fenestrella.
ovalis—Nephopteryx.
Peoria albidella Hulst.
Phalena pascuellus—Crambus.
perlellus—Crambus.
Phlyctænia externalis War.
ferrugalis Hubn.
indistinctalis War.
profundalis Pack.
Phorasea simalis Grote.
Phycis zinckenella—Etiella.
Pilocrocis inguinalis Guen.
Pinipestris fasciolalis—Nephopteryx.
Plodia interpunctella Hübn.
Pseudoschœnobius opalescalis (Hulst.).
Pyla bistriatella Hulst.
scintillans (Grote).
Pyralis farinalis Linn.
Pyrausta augustalis Grote.
coccinea War.
commortalis Grote.
fodinalis Led.
fumoferalis Hulst.
gracilalis Hulst.
laticlavia G. & R.
lethalis Grote.
mustelinalis Pack.
nicalis Grote.
octosignalis Hulst.
perrubralis Pack.
rubricalis Hübn.
semirubralis Pack.
subnicalis War.
unifascialis Pack.
vacunalis Grote.
versicolor War.
Ragonotia dotalis Hulst.
Saluria ardiferella Hulst.
dichrocella Rag.
rostrella Rag.
Sarata perfuscalis (Hulst.).
Schœnobius opalescalis—Pseudoschœnobins.
Scoparia atropicta Ham.
centuriella D. & S.
rectilinea Zell.
refugalis—rectilinea.
Selagia olivella—Anorista.
Spermatophthora gemmatella—Cayuga.
Staudingeria albipennella (Hulst.).
Stemmatophora nicalis—Pyrausta.
Stenophyes huronalis Guen.
Stericta trabalis—Yuma.
Symphysa eripalis Grote.
Tinea hortuellus—Crambus.
Titanio dapalis Grote.
immerens (Hav.).
nuchalis—Noctuelia.
proximalis Fern.
Unadilla erronella Zell.
Urulla incongruella Hulst.
Vitula serratilineella—Eccopsia.
Yuma *adulatalis*—trabalis.
trabalis Grote.
Zophodia fuscatella Hulst.
packardella Rag.

PTEROPHORIDÆ.

Aciptilis cinerascens—Alucita.
montanus—Alucita.
Alucita cinerascens (Wals.).
cosmodactyla Platyptilia.
montana (Wals.).
Amblyptilus cosmadactyla—Platyptilia.
picta—Platyptilia.
Lioptilus augustus—Pterophorus.
grandis—Pterophorus.
homodactylus—Pterophorus.
inconditus—Pterophorus.
monodactylus—Pterophorus.
paleaceus—Pterophorus.
parvus—Pterophorus.
subocraceus—Pterophorus.
sulphureodactylus—Pterophorus.
Mimescoptilus exclamationis—Stenoptila.
Œdematophorus baroni—Pterophorus.
cretidactylus—Pterophorus.
eupatorii—Peterophorus.
guttatus—Peterophorus.
gratiosus—Pterophorus.
griseśceus—Peterophorus.
lugubris—Peterophorus.
Oxyptilus delawaricus Zell.
nigrociliatus—tenuidactylus.
ningoris Wals.
tenuidactylus Fitch.
Platyptilia acanthodactyla Hübn.
adusta Wals.
albicilliata.
albidorsella Wals.
albida Wals.
bertrami—marginidactyla.
cardui—carduidactyla.
carduidactyla (Ril.).
cooleyi Fern.
cosmodactyla Hübn.
fragilis Wals.
grandis Wals.
marginidactyla Fitch.
marmarodactylu Dyar.
modesta Wals.
percnodactyla Wals.
picta (Wals.).
shastæ Wals.
tesseradactyla.
Pterophorus augustus (Wals.).
baroni (Fish).
carduidactyla—Platyptilia.
cretidactylus Fitch.
dacteodactylus—subocraceus.
eupatorii (Zell.).
grandis (Fish).
guttatus (Wals.).
gratiosus (Fish).
grisescens (Wals.).
homodactylus Walk.
inconditus (Wals.).
lugubris (Fish).
marginidactyla—Platyptilia.
monodactylus (Linn.).
paleaceus (Zell.).
parvus (Wals.).
rileyi Fern.
subochraceus (Wals.).
sulphureodactylus Pack.
tenuidactylus—Oxyptilus.
Stenoptilia exclamationis (Wals.).
Trichoptilus lobidactylus Fitch.
pygmæus Wals.

ORNEODIDÆ.

Alucita hexadactyla—Orneodes.
montana—Orneodes hexadactyla.
Orneodes hexadactyla (Linn.).

TORTRICIDÆ.

Alcerys americana (Ferm.).
foliana (Wals.).
nivisellana (Wals.).
permutana (Dup.).
Amorbia cuneana (Wals.).
Anchylopera biarcuana—Ancylis.
Ancylis biarcuana (Steph.).
cometana (Wals.).
comptana (Fol.).
pacificana (Wals.).
Archips afflictana (Walk.).
argyrospila (Walk.).
cerasivorana (Fitch).
rosaceana (Harr.).
virescana (Clem.).
Cacoœcia argyrospila—Archips.
rosaceona—Archips.
Carpocapsa californiana—Epagoge.
pomonella—Cydia.
Carposina comonana Keor.
crescentella Wals.
Commophila macrocarpana Wals.
Conchylis campicolana—Phalonia.
fernaldana—Phalonia.
intactana—Phalonia.
kindermanniana—Phalonia.
latipunctana—Phalonia.
parallelana—Phalonia.
smeathmanniana—Phalonia.
transversana—Phalonia.
Cydia inquilina Keor.
pomonella Linn.
Dichelia tunicana—Epagoge.
Dichrorampha plumbana—Hemimene.
Eccopsis punctana—Exartema.
Enarmonia americana (Wals.).
bracteatana (Fern.).
edwardsiana Keor.
larimana Wals.
luna Keor.
tana Keor.
trossulana (Wals.).
vana Keor.

TORTRICIDÆ—*Continued.*

Epagoge californiana (Wals.).
tunicana (Wals.).
Epinotia augustana Hübn.
incarnana (Haw.).
lagopana (Wals.).
liturana (Wals.).
purpuriciliana (Wals.).
Euchromia hemidesma—Olethreutes.
Eucosma agricolana (Wals.).
albangulana Wals.
atomosana (Wals.).
basipunctana (Wals.).
biquadrana (Wals.).
bolanderana (Wals.).
canana (Wals.).
cataclystiana (Walk.).
crambitana (Wals.).
culminana (Wals.).
fulminana (Wals.).
grandiflavana (Wals.).
hirsutana (Wals.).
irroratana (Wals.).
juncticiliana (Wals.).
larana (Wals.).
luridana (Wals.).
maculatana (Wals.).
miscana Keor.
nigralbana (Wals.).
palpana (Wals.).
passerana (Wals.).
perdricana (Wals.).
primulana (Wals.).
pulveratana (Wals.).
rectiplicana (Wals.).
serpentana Wals.
shastana (Wals.).
sonomana Keor.
subplicana (Wals.).
terracoctana (Wals.).
trigeminana (Steph.).
vomonana Keor.
Eudemis vacciniana (Pack.).
Eulia colfaxiana Keor.
gloverana (Wals.).
niscana Keor.
Evetria monophylliana Keor.
pasadana Keor.
sabiniana Keor.
zozana Keor.
Exartema punctana Wals.
Glyphiptera permutana—Alceris.
Grapholitha americana—Enarmonia.
bracteatana—Enarmonia.
rœssleri—Triodia.
trossulana—Enarmonia.
Hemimene plumbana Scap.
Hendecastema cuneana—Amorbia.
Hysterosia fulviplicana (Wals.).
inopiana (Haw.).
Hystricophora leonana Wals.
Idiographis Flaviplicana—Hysterosia.
inopiana—Hysterosia.
Laphoderus gloverana—Eulia.
Loxotænia afflictana—Archips.
cerasivorana—Archips.
franciscana—Tortrix.
rosaceana—Archips.
virescana—Archips.
Melissopus latiferreanus Wals.
Œnectra inconditana—Sparganothis.
pilleriana—Sparganothis.
rudana—Sparganothis.
senecionana—Sparganothis.
Olethreutes chalybeana (Wals.).
conditana (Wals.).
consanguinana (Wals.).
grisiocapitana (Wals.).
hebesana (Walk.).
hemidesma (Zell.).
infuscana (Wals.).
minimana (Wals.).
perangustana (Wals.).
puncticostana (Walk.).
rivulana (Scop.).
rubipunctana Keor.
scalana (Wals.).
subplicana Wals.
terracostana Wals.
trigeminana Steph.
utricana (Hübn.).
vetulana (Wals.).
Pandemis albaniana (Walk.).
pyrusana Keor.
Pedisca (see Eucosma).
Penthina *conditana*—Olethreutes.
consanguinana—Olethreutes.
hebesana—Olethreutes.
hemidesma—Olethreutes.
Phœcasiophora agricolana—Eucosma.
atomosana—Eucosma.
basipunctana—Eucosma.
biquadrana—Eucosma.
bolanderana—Eucosma.
canana—Eucosma.
cataclystiana—Eucosma.
crambitana—Eucosma.
culminana—Eucosma.
fulminana—Eucosma.
grandiflavana—Eucosma.
hirsutana—Eucosma.
irriratana—Eucosma.
juncticiliana—Eucosma.
larana—Eucosma.
luridana—Eucosma.
maculatana—Eucosma.
nigralbana—Eucosma.
palpana—Eucosma.
passerana—Eucosma.
perdricana—Eucosma.
primulana—Eucosma.
pulveratana—Eucosma.
rectiplicana—Eucosma.
shastana—Eucosma.
Phalonia basiochreana Keor.
campicolana (Wals.).
carmelana Keor.

TORTRICIDÆ—*Continued.*

Phalonia fernaldana (Wals.)
formonana Keor.
intactana (Wals.).
kindermanniana (Treits).
latipunctana (Wals.).
obispoana carmelana.
parallelana (Wals.).
smeathmanniana (Fabr.).
transversana (Wals.).
vachelliana Keor.
Phoxopteris *biarcuana*—Ancylis.
cometana—Ancylis.
comptana—Ancylis.
pacificana—Ancylis.
Proteopteryx albicapitans Keor.
emarginana Wals.
Pseudoconchylis laticapitana.
Pyralis smeathmanniana—Phalonia.
Retinia argyrospila—Archips.
Rhopabola vacciniana Eudemis.
Sciaphila afflictana—Archips.
argentana—Tortrix.
hebesana—Olethreutes.
puncticostana—Olethreutes.
trigonana—Tortrix.
vacciniana—Eudemis.
Semasia *artemisiana* Triodia.
bucephaloides Wals.
griscocaptana Wals.
infuscana—Thiodia.
minimana—Thiodia.
pallidicostana—Thiodia.
perangustana Thiodia.
rœssleri—Thiodia.
scalana—Thiodia.
terminiana—Triodia.
Sericaris chalybeana—Olethreutes.
puncticostana—Olethreutes.
rivulana—Olethreutes.
urticana—Hub.
vetulana—Olethreutes.
Sparganothis inconditana Wals.
pilleriana (Schif.).
rudana Wals.
senecionana Wals.
Smicrates virescana—Archips.
Spilonota trigeminana—Eucosma.
Steganoptycha agustana—Epinotia.
incarmana—Epinotia.
lagopana—Epinotia.
liturana—Epinotia.
purpuriciliana—Epinotia.
Synnoma lynosyrana Wals.
Teras albaniana—Pandemis.
americana—Alcerys.
foliana—Alcerys.
nivisellana—Alcerys.
permutana—Alcerys.
Thiodia apacheana Wals.
artemisiana (Wals.).
daracaha Keor.
griscocapitana Wals.
infuscana Wals.
minimana Wals.
offectalis Hulst.
pallidicostana (Wals.).
perangustana Wals.
rœssleri (Zell.).
scalana Wals.
tenuiana (Wals.).
Tinea pomonella—Cydia.
Tortrix argentana Clerck.
augustana—Epinotia.
citrana Fern.
comptana—Ancylis.
franciscana (Wals.).
incarnana—Epinotia.
inopiana—Hysterosia.
pilleriana—Sparganothis.
trigonana (Wals.).
urticana Olethreutes.

HYPONOMEUTIDÆ.

Aræolepia subfasciella Wals.
Calantica polita Wals.
Cerostoma cervella Wals.
instabiliella—Trachoma.
koebelella Dyar.
radiatella Donovan.
sublucella Wals.
Chalcœla gemmalis—Chorentis silphiella.
Choreutis bjerkandella Thumb.
dyarella Keor.
occidentella Dyar.
silphiella Grote.
sororculella Dyar.
Euceratia castella Wals.
securella Wals.
Glyphipteryx bifasciata Wals.
californiæ Wals.
Glyphipteryx quinqueferella Wals.
regalis Wals.
unifasciata Wals.
Orchemia diana Hubn.
Periclymenobius canariellus Wals.
dentiferellus Wals.
frustellus Wals.
Plutella albidorsella Wals.
cruciferarum—maculipennis.
maculipennis Curt.
omissa Wals.
porrectella Linn.
vanella Wals.
Setiostoma fernaldella Ril.
Trachoma falciferella Wals.
instabilella Wals.
senex Wals.

GELECHIIDÆ.

Anacampsis rhiofructella (Clem.).
Anarsia lineatella Zell.
Aristotelia argentifera Busck.
roseosuffusella Clem.
Cleodora canicostella—Paltodora.
modesta—Paltodora.
sabulella—Paltodora.
striatella—Paltodora.
tophella—Paltodora.
Dactylota snellenella—Neodactylata.
Deoclona yuccasella Busck.
æquepulvella—Glyphidocera.
apicitripunctella—Recurvaria.
Eucatoptus striatella—Phthorimæa.
Gelechia discostrigella Chamb.
griseochrella Chamb.
lacteusochorella Chamb.
laudatella.
maculatusella Chamb.
occidentella Chamb.
ocherfuscella Chamb.
ochreostrigella Chamb.
Gelechia *octomaculella*—Gnorimoschema.
operculella—Phthorimæa.
paulella (Colorado).
rhoifructella—Anacampsis.
roseosuffusella—Aristotelia.
thoracestrigella Chamb.
variabilis Busck.
Glyphidocera aequepulvella (Chamb.).
Gnorimoschema baccharisella Busck.
coquillettella Busck.
octomaculella (Chamb.).
tetradymiella Busck.
Lita solanella—Phthorimæa operculella.
Neodactylata snellenella Wals.
Paltodora canicostella (Wals.).
modesta (Wals.).
sabulella (Wals.).
striatella (Hübn.).
tophella (Wals.).
Phthorimæa operculella (Zell.).
striatella (Murt.).
Recurvaria apicitripunctella Clem.

XOLRICITIDÆ.

Ide osseela Wals.

ŒCOPHORIDÆ.

Depressaria arenella Schif.
argillacea Wals.
arnicella Wals.
ciliella Stain.
emeritella Stain.
klamathiana Wals.
novimundi Wals.
nubiferella Wals.
posticella Wals.
psoraliella Wals.
sabulella Wals.
thoracefasciella (Chamb.).
thoracenigraeella (Chamb.).
togata Wals.
umbraticostella Wals.
Endrosis lactella D. & S.
Ethmia albistrigella Wals.
albitogata Wals.
arctostaphyella Wals.
monticola Wals.
obscurella Beut.
subcærulea Wals.
Oecophora dimiidiella Wals.
pseudospretella Wals.
Psecadia albistrigella—Ethmia.
arctostaphylella—Ethmia.
monticala—Ethmia.
obscurella—Ethmia.
subcærulea—Ethmia.
Setiostoma fernaldella Ril.
Walsinghamia diva Ril.

BLASTOBASIDÆ.

Blastobasis iceryæella—Holcocera.
Dryope canariella Dietz.
fenyesella Dietz.
occidentella Dietz.
Holcocera iceryæella Riley.
Holcocera inconspicuua Wals.
irenica Wals.
gigantella Cham.
stygna Wals.
Valentina glandulella Riley.

ELACHISTIDÆ.

Butalis aterrimcla—Scythris.
ochriglriata—Scythris.
perspicelella—Scythris.
suffusa—Scythris.
Coleophora accordella Wals.
acutipenella Wals.
bella Wals.
costipenella Wals.
Coleophora cornella Wals.
discostriata Wals.
glaucella Wals.
glutinosa—(synonymy undetermined).
irroratella Wals.
laricella Hübn.
lynosyridella Wals.

ELACHISTIDÆ—*Continued.*

Coleophora ochrella Chamb.
ochrostriata Wals.
pruniella Clem.
tennis Wals.
viridcuprella Wals.
viscidiflorella Wals.
wythiæ Wals.
Cosmopteryx unicolorella Wals.
Heliodines bella Chamb.
extraneella Wals.
unipunctella Wals.

Laverna bifasciella—Mompha.
decorella—Mompha.
subbistrigella—Mompha.
unifasciella—Mompha decorella.
Mompha bifasciella Chamb.
decorella (Steph.).
subbistrigella (Haw.).
Schreckensteinia felicella Wals.
Scythris aterrimella (Walk.).
ochristriata (Walk.).
perspicelella (Walk.).
suffusa (Walk.).

TINEIDÆ.

Adela *fasciella*—trigrapha.
flammeusella Cham.
lactimaculella—flammeusella.
punctiferella Wal.
septentrionella Wal.
trifasciella Chamb.
trigrapha Zell.
Amydria coloradella Dietz.
confusella Dietz.
obliquella Dietz.
onagella Dietz.
pandurella Dietz.
Apotomia fractilinella Dietz.
Apreta paradoxella Dietz.
Argyrestia cupressella Wal.
mendica Haw.
plicipunctella Wals.
Bedellia somnulentella Zell.
Buculatrix euraticlla—(synonym undetermined).
Cremastobombycia grindelilella—Lithocolletes.
Epilegis cariosella Dietz.
Gracilaria behrensella Chamd.
elongella Linn.
fuscoocherella Beut.
nigristrigella Beut.
ruptostrigella—nigristrigella.
sanguinella Chamb.
sauzalitoella Chamb.
shastaella Beut.
Greya humilis (Wal.).
mediostriatella (Clem.).
punctiferella (Wal.).
solenobiella (Wal.).
Homoseta maculatella Dietz.
Incurvaria humilis—Greya.
punctiferella—Greya.
salenobiella—Greya.
Lecithocera flavistrigella—Greya mediostriatella.
Lithocoletes agrifoliella Braun.
alnicolella Wal.
alniella—is European.
apicinigrella Braun.
arbutusella Braun.
basistrigella Cham.
conglomeratella Zell.

Lithocoletes *faginella*—is European.
grindeliella Wal.
grindelilella (Wal.).
incanella Wal.
insignis Wal.
ledella Wal.
leucothorax Wal.
mediodorsella Braun.
nemoris Wal.
salicifoleilla Clem.
umbellulariæ Wal.
Monopsis crocicapitella Clem.
rusticella Hubn.
Orthlophus variabilis Wal.
Phyganeopsis brunnea Wal.
Prodoxus ænescens Ril.
cinereus Ril.
coloradensis Ril.
marginatus Ril.
pulverulentus Ril.
reticulatus Ril.
sordidus Ril.
y-inverus Ril.
Pronuba maculata Ril.
paradoxa Ril.
synthetica—paradoxa.
yuccasella Ril.
Paraneura cruciferella Dietz.
ehrhorniella Dietz.
simulella Dietz.
Scardia gracilis Wal.
Semiota transverstrigella Dietz.
Spicheta nepotella Dietz.
Steomorpha majorella Dietz.
Tinea arcella Fabr.
behrensella Chamb.
cloacella Haw.
defectella Zell.
geniculatella Dietz.
molybanella Dietz.
niveocapitella Chamb.
occidentalla Chamb.
pellionella Linn.
sparsipunctella.
Tineola biselliella Linn.
Tischeria badiiella Chamb.
ceanothi Wal.
sulphurea—badiiella.
Trichophaga tapetzella Linn.

HEPIALIDÆ.

Hepialis *anceps* montanus.
baronia—montanus.
behrensii Stretch.
californicus Boisd.
hectoides Boisd.
hyperboreus Mosch.
inutilis—hectoides.
lembertii Dyar.
Hepialis *lenzi*—hectoides.
meglashani—hyparboreus.
mendocinolus [illegible]
modestus—hectoides.
montanus Stretch.
rectus—montanus.
sequoiolus Behrens.

MICROPTERYGIDÆ.

Epimartygyia pardella (Wal.).
Eriocephala aurosparsella (Wal.).
Micropteryx aurosparsella—Eriocephala.
pardella—Epimartyria.

GENERAL NOTES.

SHALL THE STATE INSPECT NURSERY STOCK?

By G. E. Merrill.

Mr. Rowley's paper at the California State Nurserymen's Convention suggestive of a centralized authority to direct the inspection of nursery stock, the desire of the nurserymen for one inspection and certification at the point of origin of intercounty shipments good all over the State, their general dislike of the county horticultural quarantine ordinances, as well as the feeling on the part of some of our county horticultural commissioners that the present system of inspecting intercounty shipments of nursery stock is not perfect, all open the way for a thorough discussion of these phases of horticultural quarantine. The public as well as those vitally interested in the matter should understand that horticultural quarantine laws are police regulations, and that a township, a city, a county or a state has the power to make such police regulations as may appear essential to its welfare, provided they do not clash with a higher authority. Our horticultural regulations pertaining to the inspection of nursery stock are designed primarily to protect the grower from unscrupulous and ignorant nurserymen. Nurserymen who grow clean stock in districts that are horticulturally clean ought to have little to fear from the law.

In this article we attempt to make an unprejudiced statement of the more obvious objections and advantages of centralized state control of nursery stock inspection as compared with the system in vogue. We shall also try to show that the county ordinances are of value and that any proposed new system ought to contemplate a substitute for them.

Centralized Authority.

The administrative advantages of placing horticultural police work under one supreme head are so plainly to be seen that we shall give them no attention. The great objection to the adoption of a system of centralized authority and consequent single inspection and certification lies in the chance that its adoption might result in a less vigilant scrutiny of suspected stock. And all nursery stock is held under suspicion by the efficient inspector until it is proven to be clean. Under the present system of dual inspection the last inspection is made by an agent whose every interest should lie in the rejection of unfit stock. Under a single inspection and certification system at point of origin the chances are that the one who made the inspection would have only a mild interest in shipping clean stock to another county. This objection of course can be overcome by the establishment of a traveling corps of vigilant inspectors who would have no interest in passing the stock they inspected. Such a system, we believe, would be far more costly than our present practice.

Besides the foregoing objection, there are practical difficulties to be overcome before nursery stock inspection can be brought under the direction of a centralized authority. The changes in the law incident to the adoption of the system under discussion would be greater perhaps than many realize. Under the present law the county horticultural commissioners are paid and appointed by the counties in which they serve, and we believe it to be one of the principles of equity that to the party that pays belongs the direction of those paid. Due largely to the observance of this principle in the framing of our present laws, the county horticultural commissioners are not now subject to more complete control by the State Horticultural Commissioner. To bring them under state control would require sweeping changes in the law and an increase in the appropriation for the office of the State Horticultural Commissioner. For the year ending September 30, 1912, approximately $160,000, including salaries, was expended through the offices of the county horticultural commissioners. Those best fitted to pass on this matter are of the opinion that the duties of the county horticultural commissioners could not be performed for any less under direct state supervision.

County Ordinances.

Students of the situation are well aware that the various insect pests and plant diseases are not distributed uniformly throughout California. They are also aware that in many cases the ravages of some of the most serious pests are restricted in area. They know, too, that there are instances on record of insects becoming pests in districts that at one time were thought even by experts to be immune from the ravages of these insects. And yet in the absence of effective quarantine these insidious invaders have become established and have caused losses of thousands of dollars. Under these circumstances a county certainly is justified in passing horticultural ordinances to protect its welfare. These ordinances are not only justifiable, but they are well supported by public sentiment. They are not unconstitutional, as one speaker at the nurserymen's convention stated. They cease to be constitutional only when they conflict with the state horticultural laws. By far the larger part of California's county horticultural ordinances are thoroughly in accord with the state laws of this kind. Any new system that proposes the abolition of these ordinances should provide for some substitute for them. Should the horticultural quarantine work become centralized, one of the first duties of the head of this authority would perhaps be the establishment of certain quarantine areas within the State from which the shipment of certain classes of stock would be absolutely prohibited.

Conclusion.

Reports from the county horticultural commissioners show that comparatively little nursery stock of California origin has been lost through the operation of our laws. They also show that both domestic and

foreign stock was cleaner last year than ever before. From the standpoint of the grower we believe that our present laws are satisfactory. That they prevent the sale of much inferior insect-infested and disease-ridden stock is certain. That blunders can be made in their enforcement we do not doubt, but any new system would be subject to the same objection. We believe that the present laws should be enforced in spirit always and to the letter when the occasion demands that they be so enforced. Would it not be well to wait another year at least before beginning a new experiment in horticultural legislation?

SOME SUGGESTIONS CONCERNING PRESERVING FRUITS FOR EXHIBITS.

By A. G. Smith, Horticultural Inspector, Pasadena, California.

At least a part of the success obtained by some of those who have become expert in preserving fruit specimens for exhibition in chambers of commerce and the like is probably due to a preparatory treatment with copper sulphate before the final permanent preserving fluids are used.

Unfortunately for the common good and for scientific advancement, this *trick* is guarded as a secret by some of those who ought to be glad and willing to disseminate the information and give it all the publicity possible.

The knowledge that this "secret" method is used may assist some who are working along this line to develop a system and work out the details and give to the public rules by which not only ripe fruits and vegetables but even foliage and flowers may be preserved in a perfect state indefinitely.

The following suggestions are made as the result of incomplete experiments and with the consciousness that this is only in the nature of a preliminary report, and barring details will be found nevertheless to furnish a basis for further experiments. Considerable success has been attained along these lines in preserving specimens of fruits, leaves and twigs for the purpose of showing insect pests *in situ* with a natural condition of the plant, and it seems certain that the plan can be perfected.

The following is a brief outline for tentative working basis for more experiments as to length of time for treating and for proportions, all of which must vary according to the structure of the tissues of the plant specimen, or the fruit and the amount of juices or sap present:

First—Immerse specimen in solution of copper sulphate, 1 part to 500 to 1000 pure water, about three or four days.

Second—Siphon off fluid, wash carefully by adding water through tube reaching to bottom of the receptacle, siphon off the water and add in same manner more copper sulphate solution, double strength used first; let stand five to ten days. If plant tissues are soft or pulpy or rich in sugar, etc., add to this solution one half to one per cent glycerine.

Third—Remove fluid in same manner and let stand in pure water twenty-four hours.

Fourth—Remove water and add solution of 40 per cent formalin, 1 to 500, plus 1 or 2 per cent glycerine and 3 to 10 per cent alcohol, and let stand one to three weeks.

Fifth—Wash carefully as before.

Sixth—Add final preserving fluid. For most specimens solution of sulphurous acid 1 to 500 is best, to which may be added if necessary glycerine and alcohol as with the formalin solution.

Instead of sulphurous acid, it may be best for certain specimens to use solution of formalin for final preservative, or in some cases boracic acid, or even salicylic acid, while in a few cases more or less alcohol alone or in combination is required.

This final solution needs to be changed from time to time, whenever the growth of fungus forms a complete firm mouldy scum on the surface of the fluid.

A small air space is necessary in any sealed or glass stoppered bottle to allow for expansion of fluid at different temperatures. (The more succulent the specimen the weaker should be the solutions of copper sulphate.)

ARIZONA HORTICULTURAL QUARANTINE ORDERS.

QUARANTINE ORDER NO. 1.

Alfalfa Weevil.

Since Quarantine Order No. 1 was originally adopted a change has been made in placing nursery stock in paragraph "a" with hay, straw, etc. This change was due to the fact that nursery stock was shipped into one section of the State where considerable alfalfa was grown from a nursery in the infested district in Utah. The danger in this case was considered to lie in the packing material. When the quarantine order was originally adopted it was not realized that alfalfa growing was of any great importance in the section of the State to which these shipments of nursery stock were made.—A. W. Morrill.

QUARANTINE ORDER NO. 4.

The Grape Phylloxera.

In order to prevent the further introduction and dissemination of the grape phylloxera (*Phylloxera vastatrix*) in the State of Arizona it is hereby ordered:

(*a*) That the introduction into the State of Arizona of rooted grapevines from that part of the State of California lying north of the north line of San Luis Obispo, Kern, and San Bernardino counties is hereby prohibited.

(*b*) That grape cuttings may be admitted from that part of the State of California referred to in paragraph (*a*) only after treatment by the

Arizona State Entomologist, Assistant State Entomologist or an Arizona Crop Pest Inspector, consisting in submerging such cuttings between three and five minutes in water at a temperature between 127 degrees Fahrenheit and 131 degrees Fahrenheit.

(*c*) That all persons, firms, or corporations in the State of Arizona are prohibited from having possession of, transporting, selling or giving away any rooted grape vines or grape cuttings introduced into the State in violation of this order.

Adopted November 1, 1912.

QUARANTINE ORDER NO. 5.

The Cotton Boll Weevil.

In order to prevent the introduction of the cotton boll weevil (*Anthonomus grandis*) into the State of Arizona, it is hereby ordered:

(*a*) That the introduction of cotton seed into the State of Arizona from any other state or territory, or from any foreign country in which the cotton boll weevil is known to exist, is hereafter prohibited.

(*b*) That this quarantine order shall be immediately effective upon proper notification of persons concerned, against the following states and countries: Texas, Oklahoma, Arkansas, Louisiana, Mississippi, Alabama, Florida, Republic of Mexico, Guatemala, Costa Rica, and Cuba.

(*c*) That this quarantine order shall be extended to any state, territory or country in which the cotton boll weevil may hereafter be discovered, upon public announcement by the Arizona State Entomologist.

(*d*) That all persons, firms, or corporations in the State of Arizona are prohibited from having possession of, transporting, selling or giving away any cotton seed introduced into the State in violation of this order.

Adopted November 1, 1912.

QUARANTINE ORDER NO. 6.

The California Red and Yellow Scales.

In order to prevent the introduction of either the California red (*Chrysomphalus aurantii*), or the yellow scale (*Chrysomphalus aurantii* var. *citrinus*) into the State of Arizona it is hereby ordered:

(*a*) That the introduction of citrus nursery stock, either budded or seedling, into the State of Arizona, from any county in the State of California, with the exception of Tulare and Fresno, is prohibited.

(*b*) That this order shall not be construed to interfere with the introduction into the State of citrus bud wood under the provisions of the Arizona crop pest law providing for the inspection of shipments of such material at destination.

(*c*) That all persons, firms, or corporations in the State of Arizona are prohibited from having possession of, transporting, selling or giving away any citrus stock introduced into the State in violation of this order.

Adopted November 1, 1912.

NOTES FROM THE COUNTY COMMISSIONERS.

By G. E. Merrill.

This office is glad to note that many of the county horticultural commissioners are availing themselves of the seed testing facilities of the State Insectary and that both intercounty and interstate shipments of nursery stock are scrutinized carefully for traces of the various species of *Aleyrodes*.

Humboldt County.

A *Balaninus* sp., probably new and closely related to the lesser chestnut worm of the East, has been reported as doing considerable damage to acorns near Trinidad.

Napa County.

Some potatoes from Napa County exposed for sale in the Sacramento markets were found to be affected with the potato tuber moth (*Phthorimœa operculella*).

Nevada County.

Mr. D. F. Norton has been made a special deputy of the State Commissioner of Horticulture to act as county horticultural commissioner for Nevada County until a successor to the late Commissioner Linden Bree shall have been duly qualified.

The Jerusalem cricket, *Stenopelmatus* sp., has been reported as working on Nevada County potatoes.

Sacramento County.

Commissioner Bloomer reports considerable damage this year to carrots and potatoes from wire worms. Many badly purple scale infested lemons from San Diego have recently been rejected in the Sacramento markets.

San Bernardino County.

Commissioner Pease has recently completed an orchard survey of his county.

Sutter County.

Commissioner Stabler is engaged in making an orchard census in his county.

Ventura County.

A diseased condition in young apricot trees in certain environments is reported by Commissioner Vaile. The affected trees present a chlorotic appearance, the twigs die back for several inches and the leaves on the new growth are abnormally small in size; in fact, they are suggestive of conditions found in the "little leaf" of the peach. The diseased trees appear to exist in groups, but no indication can be

found of the presence of oak root fungus. There seems to be nothing obviously wrong with soil conditions although the trees are on somewhat heavy soil. The trees affected are on peach or apricot roots. A few trees that are on Myrobolan root do not seem to be susceptible. Possibly the trouble is due to an attempt to grow apricots on peach root on too heavy a soil.

Yolo County.

Commissioner Hecke was a recent visitor at the executive office. He was in town to attend a meeting of the directors of the Deciduous Protective League.

Yuba County.

The State Commissioner of Horticulture, in coöperation with Commissioner Harney, has recently completed a white fly campaign at Marysville.

ERRATA.

Page 19, for "*Phytonomus murinus* Fab.," read: *Phytonomus posticus* Gyll.

Pages 26-28, for "*Tylenchus dexastatrix*," read: *Heterodera radicicola.*

Page 33, for "*Anasthrepa ludens*," read: *Anastrepha ludens.*

Page 45, for "*Depladia natalensis*," read: *Diplodia natalensis.*

Page 47, for "*Rhagoletus pomonella*," read: *Rhagoletis pomonella.*

Page 66, for "*Pseudomonus cerasus*," read: *Pseudomonas cerasus.*

Page 106, for "*Eulecanium tulipiferoa*," read: *Eulecanium tulipifera.*

Page 109, for "Alberta," read: Elberta.

Page 111, for "*Sericidæ*, read: *Siricidæ.*

Page 116, for "*Aphis niger*," read: *Aphis persicæ-niger.*
for *Toxoptera aurantiaæ* read: *Toxoptera aurantiæ.*

Page 123, for "*Macrosiphum centrifolii*," read: *Macrosiphum citrifolii.*

Page 126, for "*Macrosiphun rosæ*," read: *Macrosiphum rosæ.*

Pages 128, 192-4, 284-287, for "*Coccinella abdominalis*," read: *Cycloneda abdominalis.*

Page 145, for "*Diabrotica sorer*," read: *Diabrotica soror.*

Page 174, for "*Tetranychus mytalispidis*," read: *Tetranychus mytilaspidis.*

Page 284, for "*Symphcrobius augustus* Banks," read: *Sympherobius augustus* Banks.

Pages 318, 870, for "*Parlatoria blanchardi*," read: *Parlatoria blanchardii.*

Page 711, for "*Dacus zanthodes*," read: *Dacus xanthodes.*

Page 723, for "*Rivellia persidæ*," read: *Rivellia persicæ.*

Page 754, for "*Phenacoccus marlatti*," read: *Phœnicococcus marlatti.*

Page 888, for "*Phœnicoccus marlatti*," read: *Phœnicococcus marlatti.*

Page 812, for "*Aspidiotus lantaniæ*," read: *Aspidiotus lataniæ.*
for "*Chrysomphalus aonidium*," read: *Chrysomphalus aonidum.*

Page 814, for "*Calandradæ*," read: *Calandridæ.*

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